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OUR WILDLIFE AND ITS WISE USE

By

WIN DONAT, Ass't. Chief
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N. C. WILDLIFE RESOURCES COMMISSION

NORTH CAROLINA RESOURCE BULLETIN SERIES



Other cooperating agency publications:

1. "Public Welfare in North Carolina," N. C. State Board of Public Welfare.
2. "Our Surface Waters and Their Problems," N. C. Department of Conservation & Development, Water Resources Division.
3. "Conservation of Soil and Water," U. S. Soil Conservation Service.

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NORTH CAROLINA RESOURCE BULLETINS

These bulletins are sponsored by the North Carolina Resource-Use Education Commission and various agencies of the state. The Commission, composed of representatives from fifty state and federal agencies, was organized in 1945 for the purpose of further channeling resource-use education into the schools and communities. It is hoped that the bulletins will furnish teachers and other leaders information as to the human, social and natural resources of North Carolina, and that they will point out the problems of resource development and conservation. Some practical suggestions toward solving these problems will be included.

Bulletins on welfare and on wildlife have been published. Individual bulletins may be prepared on health, recreation, industry, agriculture, soil conservation, forestry, water, and minerals. Others will be added as the need arises.

Scientific information is needed to develop the resources in North Carolina, but only if our human resources are wisely used can our state greatly increase the present output of goods and services so urgently needed by her citizens. These citizens are a vast reservoir of spiritual, intellectual and physical energy not being used fully at the present. Too few people have the vision, knowledge and skill necessary to enjoy the wealth of resources now lying unused and wasted within their reach.

We are just beginning to learn of the natural riches of our state. Once known, this will mean a more stable economy with better agriculture, new industries, more opportunities, and more effective public services for all.

Trained scientific technicians daily uncover more of nature's materials and forces which, when released, will increase the productive powers of the land, minerals forests, waters, and wildlife. This will be possible if the waiting natural wealth, the growing knowledge of scientists, is joined by the understanding, faith, efforts, and knowledge of the people for a richer, happier, society. Only a new spiritual and scientific awakening of the people through a continuous educational crusade, can achieve this.

North Carolina's future lies in the full development of her natural, human, and social resources. We can start in our classrooms and communities to improve the living conditions by the fullest use of all three types of resources. To do this, three major factors of the community must be considered. These set the standards, or the living level, of the respective areas.

First is the physical environment, or the *natural resources*. These are the sun, land, minerals, water, plant and animal life. They provide the bases for the food grown, the clothes we wear, the houses we live in, the metals and fuels mined from which our many machines and gadgets are fashioned, as well as many of our recreational opportunities.

Second, there is man, or the *human resource*.

The third factor is created by man's desires, wants, work, play, and his association with the people of the community—the *social resources*. Man draws upon his natural and social resources to give him the goods

and services he wants and needs. The knowledge, skill and customs of the people set the direction and quality of individual and group effort towards satisfying these wants.

The social resources are made up of groups like the family, and educational, economic, governmental and religious organizations. They include many less formal public and private groups such as the Parent-Teacher Associations, cooperatives, and civic clubs. Organizations spring from the customs and laws of people, and provide the social forces operating in the community.

The forces of nature and the forces of our social life, give man two systems of power. Man, to make the fullest use of either of these two powers, must understand the scientific principles governing their operation. Man's ignorance, or lack of energy, can keep his community from reaching its capacity in the production of both material goods and in mature and active citizens. The human, natural and social resources must be woven together in order to realize the fulfillment of the community's development. Each community must be stimulated and guided to fill the needs of its people. It is the task of teachers and leaders to make urgent these needs and wants to the people so that all persons will work for them.

There is, then, urgent need that the people of North Carolina understand the principles of wise resource use; that they apply their understanding and skill to achieve better living in the community, state and nation. This is a great challenge to our schools for they carry the largest burden in educating youth and adults in the wise use of resources. These bulletins should aid considerably in building sound school programs which meet the challenge of our times.

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OUR WILDLIFE AND ITS WISE USE

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WIN DONAT

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OUR WILDLIFE AND ITS WISE USE

I. THE INTERRELATIONSHIP OF OUR RESOURCES

Any attempt to describe the natural resources of North Carolina is a tax on the imagination. The varied soils, thousands of miles of streams, lakes and waterways, the temperate climate and a progressive citizenry all combine to make our state the leader of the southern states in many fields.

Although it is true that the industry and enterprising nature of the people of North Carolina have advanced the state to a position of leadership, it is just as true that all progress in the past and future is dependent upon the manner in which the two basic resources, namely the soils and the waters, are used. Too often the importance of our soils and waters have been underestimated or neglected, and yet all that has been achieved or will be achieved in the future could be traced back directly to one or the other, or both, of these fundamentals. No longer can these factors which contribute so vitally to our very existence be taken for granted, nor can they be considered as inexhaustible.

In order to give a proper value to any one of the activities which deal with our natural resources, it is necessary to recognize the relationship of all of these resources to each other and then determine whether our past and present use of them is wise and efficient. Since *land, water, forest, minerals, wildlife, and people* are the resources of North Carolina, and since people are the most important resource, we must establish our values of the others in terms of the extent they can be and are used by the people.

A brief list of the chief activities to be found in North Carolina would show that it is primarily an agricultural state. It is evident that the farming needs are concerned with soil and water management as well as climatic conditions. Modern farming methods are becoming more widely practiced and the science of farming is leading the way to larger and more valuable crops. The activities of well-organized youth groups are developing our rural youth to an awareness of the need for sounder farming practices. As a result,

more of our young people than ever before begin their life on the farm, not only with more knowledge based on sounder principles but with a deeper understanding of the soil and the best ways to use it.

The farm is the test ground for conservation, and the practice of wise use must begin with the soil and water in order to maintain and improve the present high standard of living of our farm communities.

Forestry and the manufacture of wood products may be considered as separate activities, they are directly dependent on the lands, waters, and climate for their establishment in the same way and to the same extent as the farmers' crops.

Many thousands of our people obtain a large part or all of their income directly or indirectly from the forests of North Carolina or their products. The manufacture of furniture, paper and almost limitless wood products, together with the actual growing and harvesting of the various woods required is a major industry. Only when the elements of soil and water are wisely used to grow trees for man's needs can there ever be an adequate source of supply. It must be remembered that wood, like tobacco or cotton, is a crop and it must be grown.

The mineral resources of the state only now are being developed to the point that they constitute a major industry and they, too, are found to be a direct product of the land. At present, clay products, mica, feldspar, bromine, stone, sand and gravel are the principal mineral products. As man's needs increase and greater demands are made on the present sources of supply, the minerals of North Carolina will play a more important part in providing income for our people.

Of the major resources, wildlife is usually the last to be considered. It is, however, just as important to our welfare, happiness and prosperity. Wildlife in North Carolina can exist and thrive only where there are suitable lands, forests and waters, and *when the people recognize it as a valuable resource*. The words "wise use" are often given as another definition for conservation. Let us now discuss this resource in more detail and examine the past and present uses to determine whether conservation fits into the picture for the future.

When the earliest colonists arrived, the condition of the relationship among the land, water, and climate and all living things

dependent upon these factors, was such that it might better be described as a gigantic scale or balance. The life producing and sustaining elements might be considered as being on one side of the scale and all living things on the other. If this idea of a balance is kept in mind, it will be easier to see how the use and abuse of the basic elements has destroyed the balance and thus produced some of the conditions which cause our present wildlife problems. For instance, the ill-advised draining of marsh and swampy areas to provide more farm and grazing lands has destroyed the breeding places for waterfowl and valuable fur-bearing animals.

In order to show how this principle of balance works, how it applies to our wildlife, and how it affects many of the factors previously mentioned, even to the very lives of the people of North Carolina, let us discuss the past use of our forest resources.

Not long ago the forests of North Carolina covered a much greater area than they do now. Numerous species of birds and animals lived in them and obtained their food from them. Chief among these were the deer, bear, opossum, raccoon, squirrel, grouse, and wild turkey which depended on the forests for a place to raise their young and as a source of food. These creatures were in turn hunted and trapped to provide food and clothes. In fact, it may be said that our nation might have failed to live in its early days if it had not been for the abundance of wild animals and birds which provided a principal source of food and clothes and income for our ancestors.

Throughout the years, as the farms and towns moved farther to the west, man's uses of the lands, forests, and waters became more intense, and coupled with his greed and wrong belief that there always would be enough, there began a wasteful period of activity in which serious damage has been done to the forests and many of our other resources.

In order therefore to show more clearly how the balance of nature is affected by the things we do, let us, by the use of one resource as an illustration, show how the forest land is so definitely related to man, his welfare and activities. This example also will show that nearly all the resources of North Carolina are related and that a serious abuse of one has its effect on others.

The forests themselves perform a valuable function in many ways. The tree roots hold the soil in place on the steep hillsides. The dead and decaying leaves on the forest floor aid in holding

rain water and water from melting snows in many small puddles no larger than large raindrops and allow this water to seep into the ground whence it finds its way to underground streams and finally through springs into our larger streams and rivers.

As man's numbers and needs increased through the years, he found that the wood available in the forests was becoming more valuable. Many of the great individual fortunes of today had their beginning in the use of the forests and their products. The trees were cut down with no thought for the future; den trees which were the homes of small animals were destroyed even though they had no commercial use; and what is most important, no attempt was made to replace the trees taken by planting young trees.

Thousands of acres of North Carolina's timberland are burned each year by careless people. Fire is perhaps one of the most disastrous abuses of our forests because it not only kills the trees and wildlife but destroys the water control properties of the forest. The rains fall directly to the bare ground without the interruption of the trees and their foliage. The drops quickly run together to form puddles, the puddles overflow and combine to form small floods. When this procedure is repeated many times and many small streams finally merge with a river, the result is a big flood. It must be remembered that water cannot be poured into a funnel in a greater volume than the small end will discharge; likewise the carrying limits of a stream system cannot be exceeded if floods are to be avoided.

The bad effects of floods are too generally known to everyone to require great detail; therefore, we mention a few such as the destruction of land, buildings, herds and flocks, crops, income, and much of our wildlife. The Roanoke River bottom areas, for instance, which are densely wooded and quite often flooded are the home of one of our largest wild turkey populations. These great birds nest on the ground and the young birds are extremely vulnerable to moisture. They easily contract certain diseases if they get chilled and wet. Floods destroy nests and are harmful to many species of birds and animals.

Among the effects of forest fire previously mentioned, there is one that is not apparent and that is the destruction of certain species of fish. The western North Carolina mountain section has been popular with sportsmen who come to that area to fish for trout. These sportsmen bring much revenue into the mountain

areas thereby benefiting the people who serve them. Trout are excellent game fish and can live only in the clear, cold, swift mountain streams. When the forest cover which shades these streams is destroyed by fire or axe, the temperature of the water is raised by exposure to the sun. Trout will not survive and reproduce under these conditions; therefore, sportsmen will not continue to come to troutless streams and the revenue they would otherwise contribute is lost.

It is estimated that more than four billions of dollars are spent annually over the nation by hunters and fishermen. North Carolina's share in this volume of business depends entirely on how well we manage our wildlife resources to provide good hunting and fishing.

Thus it may easily be seen that there is a relationship between all resources—each depending on the other to a greater or lesser degree for existence. Perhaps this interrelationship can best be illustrated by remembering the childhood jingle entitled "The House That Jack Built," particularly as the chain of events related in that poem can aptly be applied to some of the ills which are evidence of our present wildlife and conservation problems.

In wildlife management, these problems concern the decreasing numbers of game animals, birds, and fish. Let us consider briefly the causes.

Probably the most important cause of decreasing populations has been the destruction and reduction of the types of habitat on the lands and in the waters which are most favorable to wildlife. Careless timbering methods, together with changed farming practices and increased hunting and fishing pressure, are limiting factors. Fields are cropped from border to border and wire fences take the place of the zigzag rail fences and their accompanying tangle of honeysuckle and blackberry briars. Land has been cleared in large blocks; many of the isolated islands of thickets and trees have disappeared and with them the coveys of quail and other species which lived there.

The most important problem is the attitude of man. Until recently, game was so plentiful that it was slaughtered for the market. The eventual shortage of certain species was deemed impossible. In fact, such species as quail, rabbits, and waterfowl were taken for granted. The annihilation of the passenger pigeon, Labrador duck and the near extinction of the Carolina parakeet,

trumpeter swan, bison, and many others has awakened the consciousness of many of our sportsmen to the great need for an educational movement and a concerted effort to check the downward trend of our wildlife population through careful management.

Our General Assembly has placed the management of these affairs in the North Carolina Wildlife Resources Commission in order to establish such a conservation program. This is only one step towards the cure. This agency of the state government consists of nine representatives from nine wildlife districts throughout the state, each district comprising an average of about eleven counties. It is therefore evident that the varied interests and areas of the state as a whole come before the Commission, and it is on this representative group that the responsibility for laying the broad general policy is placed.

The Commission staff is separated into the following divisions: Fish, Game, Law Enforcement, Education, Finance and Personnel, and Engineering. Each of the divisions is further divided to provide for its necessary operational functions and staff.

The effort of the Wildlife Resources Commission and its staff is directed to the protection of our existing game and fish through laws and regulations and their enforcement, the repopulation of depleted areas with game and fish, the education of our citizens regarding the value and efficient use of our wildlife species, and above all, to a wise, sound, and efficient management of the entire program.

The production of this booklet and the monthly publication of the magazine, WILDLIFE IN NORTH CAROLINA, with technical bulletins covering game and fish management, as well as the maintenance of a film library, are some of the educational activities engaged in by the Commission. In addition, a regular weekly program is broadcast by a number of radio stations which give state-wide coverage. The Commission staff has many qualified consultants and speakers who are available for conducting programs.

The remainder of this booklet will be devoted to the mammals, birds, and fish which are found in North Carolina. Under each general class the booklet deals with conservation problems; kinds and adaptations, and their importance with respect to their use by man. Finally, at the end of the section covering each major class, there is a list of activities which are practical demonstrations of the significant points brought out by the text.

MAMMALS



Gray squirrel.

II. FACTORS IN THE CONSERVATION, RESTORATION AND MANAGEMENT OF MAMMALS

A. HABITAT

The destruction of favorable habitats has been the principal cause of the decline of most useful wildlife species; hence the improvement of habitats will be an important factor in their conservation and restoration. The increasing demand for game makes habitat production necessary.

The three essentials for a favorable habitat are food, water, and cover. All of these must be present in close proximity. The absence of any one is likely to limit seriously the population of wildlife.

1. Poor forest management harms mammals—good management helps them.

- a. The clear cutting of forests has been generally unfavorable to fur and game mammals.

b. In North Carolina hundreds of acres of timberland are being cleared each year. Many thousands of acres of non-productive land, however, are now regarded as better adapted to forestry than to farm crops.

c. Clearing has reduced the quantity and quality of game cover. For the protection of the raccoon, opossum, and squirrel, the destruction of den trees is prohibited by law.

d. Clearing has destroyed much food such as nuts, fruits, and berries, and in some places has reduced the population of some smaller animals which serve as food for the furbearers.

e. Clearing of timber from steep hillsides has accelerated runoff and erosion resulting in irregular stream-flow and silting of channels.

f. Proper management of farm woodlots to insure a permanent stand of timber improves the habitat for woodland mammals.

2. Good farm management practices contribute to the conservation of wildlife—bad practices to its decrease.

a. Intensive farming has followed clearing on much land.

b. Clean farming has destroyed much of the natural cover such as fencerows, brushy land, weed patches, and grassy ditches.

c. Intensive farming has increased the total potential food supply for wildlife, but frequently the food is not available, either because of insufficient cover or travel lanes, or because clean farming leaves insufficient food for the winter depression.

3. The conservation of water is related to wildlife management.

a. Drainage has been a factor in the destruction of habitat.

(1) Drainage of marshland has the dual effect of reducing the total water area and lowering the water table.

(2) Muskrat, mink, otter, beaver, and waterfowl are more affected by drainage than upland species.

(3) Any future plans for drainage or other water control projects should consider the value of the land for wildlife as well as for agriculture.

b. Some larger ponds, properly constructed and managed, provide suitable habitat for muskrats. A good farm pond should have an area of at least one-fourth acre and a grassed drainage basin of at least three acres. The minimum depth of the deepest third of the pond should be eight feet.

c. Ponds serve other useful purposes: the conservation of

water, the checking of erosion, and the production of fish. They hold in reserve for domestic and wild animals a supply of water which would otherwise escape as runoff. The retarding of runoff from small watersheds reduces the amount of erosion and helps to prevent the flooding of larger streams in periods of heavy rainfall.

4. *Careless* burning of fields and woods has detrimental effects.
 - a. It destroys food and cover for wildlife.
 - b. It destroys nests and young animals.
 - c. It damages the quantity and quality of timber.
 - d. It increases erosion by destroying plant cover.
 - e. It destroys the organic matter of the forest floor.
5. Overgrazing of pasture and timber land has accompanied intensive farming.
 - a. Closely-grazed land is unsuited to practically all forms of wildlife.
 - b. Overgrazing leaves the land without adequate plant cover to prevent erosion.
 - c. Overgrazing destroys shrubby borders around woodlots; the presence of such a border is one earmark of a good wildlife habitat.

B. CONTROL OF PREDATORS AND CROP DESTROYERS

1. The North Carolina Wildlife Resources Commission co-operates with the counties in providing the services of consultants where conservation problems require attention.

2. Many of the game and furbearing species are potential destroyers of poultry, although comparatively few individual members ordinarily engage in such activities.

3. Measures directed toward the control of predators should seek to eliminate *individual animals caught in the act of destruction*, but not to annihilate an otherwise useful species.

4. The methods used in the control of predators should be those which have been tested by experience. Uncontrolled public destruction of any predatory species by poisoning, shooting, trapping or other methods should be avoided.

5. The control of crop-destroying mammals is more difficult than the control of predators. The whole problem is made more

complex by the interdependence of the predators and crop-destroyers, hence a normal population of the former is one of the best means of controlling the latter.

C. DISEASES AND PARASITES OF MAMMALS

1. Diseases and parasites may play an important part in limiting the population of a species. Three examples of animal diseases communicable to man or livestock are tularemia of rabbits and other wildlife, hoof-and-mouth disease which once appeared in California deer, and rabies, which has been found in skunks, foxes, and in other animals.

2. The accumulation of knowledge concerning diseases and parasites is limited by the difficulty of studying animals in the wild. Research on this problem has been largely confined to (a) study of wild animals reared in captivity, particularly on fur farms, and (b) post mortem examinations.

3. Diseases of wild animals are apparently closely related to the problem of population cycles—i.e., the periodic rise of the population of a species to a certain upward limit, followed by a decline to a lower limit. It is not known whether cycles are the cause or the result of diseases and parasites.

D. HUNTING AND TRAPPING

1. Game and furbearers should be regarded as a crop of the land and managed as such. This basic principal is most important to wildlife management.

- a. Most of the animals in excess of an adequate breeding reserve may be harvested for man's use.

- b. If animals in excess of the carrying capacity of the land are not harvested by man, *they will be destroyed* by natural agencies—starvation, exposure, predation, disease, or others.

2. Excessive hunting, if continued, may destroy the breeding reserve.

- a. The harvesting of species such as the mink, muskrat, otter, and beaver should be closely regulated until a sufficient breeding reserve has been built up. At present, there is no beaver trapping season in North Carolina.

- b. Excessive hunting is most common near urban centers.

3. Improvement of environmental conditions should accompany regulated hunting and trapping.

a. Restriction of hunting and trapping without improvement of habitat will not restore wildlife.

b. Conservation of game and furbearing mammals is a joint responsibility of the landowner, the trapper, and the sportsman.

c. State laws and regulations governing the hunting and trapping of game and furbearing animals should be known and observed by everyone.

E. PROTECTION OF SMALL MAMMALS

1. The word protection as used here does not necessarily mean legal restriction of kill. Rather, it is intended to mean the voluntary prevention of unnecessary destruction of those small mammals which are beneficial to man.

2. As the food habits and life histories of shrews, moles, bats, chipmunks, and some other small mammals become better understood, these animals may be given the protection which their importance justifies.

F. THE IMPORTANCE OF BUFFER SPECIES

Although any animal can be said to belong to a buffer species, we generally assign to this group those which are of less importance to man. Common examples are rats, mice, snakes, and grasshoppers. These are taken by the larger animals, thus providing a ready source of more easily caught food in a quantity sufficient to satisfy the larger species over a greater part of the year. The fox, for example, depends on normally abundant populations of rats and mice for its food; and to a much lesser extent on game animals and birds. This is true in the case of many of our predatory species.

III. THE IMPORTANCE OF MAMMALS

Any grouping of mammals on the basis of importance is impossible. In one region an animal may be considered a valuable game or fur species, whereas in another it may be considered a harmful predator or crop destroyer. In spite of this fact, it is possible to consider mammals as being important to man in four ways:

A. FURBEARERS AND PREDATORS

1. Fur has always been an important resource in our state and nation.

a. The value of the fur catch in North Carolina increased greatly from 1920 to 1930. By 1946, the value had declined to approximately \$460,000 from a much greater amount in 1930. The principal causes of the decline were: (1) the lower prices paid to the trappers and hunters for raw furs and pelts, and (2) the increasing scarcity of furbearing animals.

b. In 1930, the annual fur catch of the United States was valued at \$70,000,000. This was greater than the combined production of fur in Canada (\$18,000,000) and Russia (\$35,000,000).

c. In 1930, furs ranked ninth in value among the imports of the United States, and twentieth among the exports. The total value of fur imports at that time was \$122,000,000.

d. In 1929, there was a \$500,000,000 turnover of furs in the United States. By 1935 the annual turnover had dwindled to \$150,000,000. Drought and depression contributed to this decline, but scarcity of furbearers also was a factor.

e. The United States now imports furs from 80 countries; millions of dollars worth of rabbit skins are imported annually.

The following table summarizes the total fur catch in North Carolina as reported for the season 1947-1948:

<i>Species</i>	<i>Number</i>	<i>Species</i>	<i>Number</i>
Muskrat	105,406	Opossum	14,956
Skunk (striped)	883	Bobcat	44
Raccoon	26,768	Mink	11,800
Weasel	797	Gray Fox	3,555
Otter	801	Civet (spotted skunk)	36
Red Fox	114		

This table shows that for the state as a whole, the muskrat, raccoon, opossum, and mink ranked first, second, third, and fourth respectively.

2. Most of the predatory mammals are also considered furbearers.

a. Bobcats have the legal status of predatory animals in North Carolina and are not protected by law at any time.

b. Weasels, minks, skunks, foxes, and opossums occasion-

ally destroy poultry. Sometimes it may be necessary to kill the offending individuals, but it is not necessary to condemn a whole species because of this behavior on the part of a few.

Predation is a natural method of maintaining a balance among wildlife species. The animals most easily taken by predators are those which disease, injuries, or stupidity make unfit to survive. This limiting factor is beneficial to wildlife in general.

d. Predation is usually greatest during periods of drought, food shortage, or other abnormal conditions. Under such conditions, many birds and mammals could not survive even without predation.

e. Predation in most instances tends to prevent a species from over-populating its range and thus destroying its food supply.

f. Predation on livestock is frequently wrongly evaluated. Foxes are often blamed for killing quail and turkeys when dogs, cotton rats, and stray cats are the real culprits.

The general tendency is to overestimate the extent of predation and to underestimate the benefits accruing from the destruction of insects and harmful rodents by so-called predators.

g. Much scientific investigation is needed before the true significance of predation can be appreciated.

B. GAME AND RECREATION

1. Some species of furbearers, particularly the red fox and the raccoon, are valued for the sport they provide as much as for their pelts.

2. Recreation is the most important feature of nearly all hunting.

3. The number of hunting and trapping licenses issued in North Carolina during the fiscal year 1947-1948 was as follows: 77,808 statewide; 53,904 combination hunting and fishing; 109,201 county; 2,685 non-resident; 1,161 statewide trapping; 2,000 trapping.

The number of fishing licenses issued in North Carolina during the calendar year 1948 was as follows: 39,588 statewide; 63,302 resident day permits; 14,558 county; 2,973 non-resident; 26,515 non-resident 1 and 5 day permits.

4. The furbearing and game mammals are a source of interest

to many people who do not hunt. Although most animals are difficult to observe in the wild, a large and growing section of the public is interested in studying and photographing them in their natural habitat.

5. In North Carolina, nearly 1,250,000 rabbits are killed annually for sport and food. They make a significant contribution to the meat supply.

6. Our game and furbearing mammals provide sport for many thousands of hunters.

C. USEFUL FOOD-HABITS OF SOME MAMMALS

1. The furbearing mammals and some of the smaller mammals supplement the work of birds in the destruction of harmful insects.

2. About 98 per cent of the food of skunks consists of insects, field mice, and similar foods. The fox, opossum and raccoon also feed in part on insects.

3. Other small mammals such as shrews and certain mice feed almost entirely on insects.

a. Shrews are particularly valuable for their work in destroying forest insects. Because of their rapid rate of reproduction, shrews are usually present in large numbers whenever there is a large quantity of organic matter in the woods. The rapid rate at which their bodies change food to energy makes it necessary that they eat almost their body weight in insects every day.

b. The mole is also valuable as an insect-eater; nevertheless it is frequently condemned by farmers and gardeners. It burrows in search of insects which attack plant roots but it does not eat the roots.

c. Bats are nocturnal in habit, and their value in the control of insects, although not well known, is thought to be considerable.

4. Foxes and other furbearers play an important part in preventing an excessive population of rodents and thus help to maintain nature's balance among the various species.

5. The useful food habits of the fur and game mammals more than compensate, in nearly all instances, for any predation on poultry and livestock and damage to farm crops.



Photo Courtesy U.S. Fish & Wildlife Service

The beaver, once extinct in North Carolina, has several colonies in the Sandhills area.



The black bear, our largest game animal, inhabits dense swamps and rugged mountain country.

The cotton rat could menace our crops and quail populations. Hawks and foxes help to keep them under control.



The opossum is our only marsupial and is found all over the state.



D. HARMFUL FOOD-HABITS AND OTHER ACTIVITIES

1. Some field mice destroy stored grain and grain in fields.
2. The Norway rat and the house mouse are probably the most destructive and undesirable of all the mammals from the human standpoint.
3. Rabbits and certain mice, if present in numbers, frequently damage young trees, shrubbery, and gardens.
4. Squirrels, raccoons, and bears sometimes concentrate in sufficient numbers to do considerable damage to stored grain and to corn in the "milk" stage.
5. Groundhogs do some damage in hayfields by building mounds of dirt which interfere with the operation of the mower.
6. Individual bears develop a taste for livestock and all bears have an inherent taste for honey where the hives are exposed to their raids.
7. Deer have a fondness for peanut and sweet potato crops as well as orchard fruits.
8. In considering the harmful activities of mammals there are two important conclusions: (a) Most species have some valuable characteristics, even though in large numbers they may at times be harmful; (b) When any species becomes seriously detrimental the cause may be man's own disturbance of the natural balance which normally controls the populations of all species.

IV. KINDS AND ADAPTATIONS

A brief summary of the characteristics and adaptations of some of the common mammals is here presented. Scientific names are given sometimes for the convenience of those who may wish to pursue a more detailed study. Such names are universal in meaning, whereas common names vary widely; for example, the name woodchuck is applied in some states to the groundhog, and in others to the mountain beaver.

All mammals are vertebrates in that they have backbones made of a series of vertebrae. They differ, however, from other vertebrate animals in possessing two unique characteristics: (1) The body has an external covering of hair. (2) The young feed upon milk produced by the mother.

Mammals, like birds, are warm-blooded and maintain a fairly

constant body temperature. They vary in size from the smallest shrews to elephants and whales. They occupy four general types of habitat: (1) Underground (fossorial) or digging mammals; for example moles. (2) Water (aquatic mammals), e.g., whales. (3) Land (terrestrial mammals), e.g., foxes. (4) Tree (arboreal mammals), e.g., squirrels. Some occupy two or more types of habitat—i.e., they spend part of their time on land and part in water. The mink, muskrat, and otter are examples.

Mammals, like all other animals, have special characteristics (adaptations) which enable them to live under special conditions. Some of these adaptations are seen in their structure; others appear in their activities.

On the basis of food habits, there are four general groups of mammals: (1) flesh-eaters, (e.g., mink); (2) plant-eaters, (e.g., rabbit); (3) insect-eaters, (e.g., mole); and (4) general feeders, (e.g., opossum).

One can distinguish among our native mammals seven general groups. In the following paragraphs some common examples of each group are briefly discussed though by no means all that are found, even in North Carolina, can be mentioned:

A. POUCHED MAMMALS (ORDER MARSUPIALIA)

The opossum (*Didelphis virginiana*) is the only North American representative of this group, which also includes the kangaroos of Australia and their relatives. The young opossums are born in a very immature condition and are carried in a pouch on the belly of the mother for several weeks. Even after they are able to care for themselves, the young return to the pouch when frightened. Dens are made in hollow trees, among tree roots, and in banks or ledges. Two or three litters, each containing from 5 to 14 young, are born each year.

Opossums increase rapidly under favorable conditions. They eat almost any sort of vegetable or animal matter, including dead animal matter (carrion). They inhabit forests, woodlots, and even ditches along hedge fences on our farms.

One special adaptation of the opossum is a long, naked tail which enables the animals to grasp the branches of a tree.

The opossum is one of North Carolina's most abundant furbearers, and has increased in number during the past five years.

B. MOLES AND SHREWS (ORDER INSECTIVORA)

1. The moles are highly adapted to their particular habitat. They live in underground burrows and feed almost entirely on insects. Their eyes are very poorly developed and external ears are lacking, but the inner ear is sufficiently developed to enable the animal to respond quickly to vibrations such as those caused by footsteps near the burrow.

The mole has a long, pointed snout adapted for pushing through the earth. The front legs are short, shovel-like structures with heavy claws for digging. The animal is poorly adapted for movement on the surface, and its usual defensive reaction is to burrow downward very rapidly. The body is almost cylindrical, the front half being somewhat larger than the rear. The tail is short and hairless. The body is covered with fine, soft fur.

2. The shrews are among the smallest of the mammals. They live mainly in the organic matter and leaf litter of the forest floor, where they make networks of small tunnels. They feed upon insects and occasionally kill field mice or others of their own kind. The shrews have pointed noses and feet adapted for digging. Because of their small size and their habits, they are little known or appreciated by most people. The little short-tailed shrew and the Carolina short-tailed shrew are representative species found in our state.

C. BATS (ORDER CHIROPTERA)

The bats are the only flying mammals. Some squirrels are called flying squirrels because they have the ability to glide through the air from treetops to the ground, but they do not fly.

Bats live mainly in caves or other darkened places and seldom venture out except in the evening and at night. The mouth opens wide to permit the catching of insects in the air. The wingspread of a bat is very large in proportion to the size of the body, giving the animal remarkable powers of flight. The feet are very small and are used mainly for clinging to rocky walls and other steep surfaces. The body is covered with fine hair, but the wings are naked. The bat has well developed vision and a remarkably acute sense of hearing.

Many of man's modern devices for navigation both in the air and on the sea use either reflected sound or reflected electrical

impulses as their basic principle of operation. The bat emits sounds which are so high pitched that the human ear cannot hear them. These sounds are reflected from objects in the creature's path and thereby warn it in time to permit a change in the course of flight to avoid the obstacle. Thus bats can fly skillfully in total darkness.

D. FLESH-EATERS (ORDER CARNIVORA)

1. The raccoon (*Procyon lotor*), is one of the best known and most popular game mammals. An adult raccoon is about 32 inches long (about as long, but not nearly as tall, as a medium sized dog). It has a bushy tail encircled with alternate bands of light and dark fur.

Raccoons live along the wooded shores of streams and lakes and the bordering lowland forests. Dens are usually in hollow trees, though the animals frequently use ground dens or small caves in cliffs. There is one litter a year, averaging 4 young.

Raccoons travel almost entirely at night. Their food consists of clams, crayfish, frogs, turtles, insects, nuts, fruits, corn, and other grain, and occasionally birds or their eggs.

Being particularly abundant in the east, raccoons are widely distributed in the wooded areas throughout North Carolina. For the past several years they have been maintaining themselves in North Carolina in increasing numbers.

2. The mink (*Mustela vison*), is reddish brown and about as long as a house cat though much more slender. Dens are in banks of streams, under tree roots, and in hollow logs or stumps. The nest is made of grass and leaves and is lined with feathers, hair, or other soft material. One litter, averaging 5 to 6 young, is born in April or May. The young have no fur at birth and are helpless.

The mink's food consists of small mammals, birds, frogs, fish, crayfish, fruits, and eggs. Because of its slimness, a mink can enter small holes and crevices in search of prey, and it is feared by other small animals. Mink are present in nearly all parts of North Carolina, but are most abundant along the wooded streams and marshes of the coastal region.

Like the skunk, the mink is equipped with scent glands which give off an offensive odor, but unlike the skunk the mink cannot project its secretion.

Mink fur is one of the most highly prized of the day, and

those who own it are considered to be at the peak of luxury. Mink farming is a profitable business, therefore, and is increasing in popularity as several variations of fur are being developed.

3. The skunk (*Mephitis*), is a relative of the weasel and mink. There are two species of skunks in North Carolina. They compare with the opossum in size and have various color patterns of black and white fur or they may be entirely black. The bushy tail is usually carried erect. Skunks are found in areas of mixed woodland and fields, in the bottoms, and along brushy borders of creeks and ravines. Dens are in deserted ground-hog burrows, in small cavities among rocks, in hollow logs, or under tree roots. A single litter of 4 to 10 young, usually about 5, is born in April or May. The food consists mainly of insects, fruit, eggs, and small rodents. Less than 1 per cent of the food of skunks consists of poultry and game birds.

4. The spotted skunk (*Spilogale putorius*), is commonly called the civet cat. Civets resemble skunks, but are smaller and usually have spots instead of stripes on their back. The habitat and food habits are similar to those of the skunk, but civets are more consistent eaters of rats and mice. One litter of 2 to 6 young is born in April or May.

In North Carolina, civets are more often found in the western mountain counties. Much less numerous than skunks, civets are apparently maintaining their numbers.

5. The red fox (*Vulpes fulva*), is a relative of the dog and wolf. A red fox is about the size of a small dog. The den is in the ground or among rocks, and it usually has more than one entrance. The average number of young a year is 6, born in a single litter. The food includes small rodents (principally mice and cotton rats), rabbits, birds, reptiles, insects, grain, fruits, berries, and carrion (decaying flesh).

Red foxes are found in most of North Carolina, being more numerous in the western half of the state. They have increased in numbers in recent years.

6. The gray fox (*Urocyon cinereoargenteus*), is generally similar to the red fox in size, life history, and food habits. It is most common in the central and eastern parts of the state and is increasing in numbers.

7. The bobcat, or bay lynx (*Lynx rufus*), in appearance and habits is similar to its close relative, the Canada lynx. A mature

bobcat may be 36 inches long, and may weigh 20 or 25 pounds. It has long legs, large feet, and a short tail.

There is one annual litter of 2 to 4 young, born in April or May. The den is located in a hollow log or in a hole among the rocks. The bobcat travels almost entirely at night and is seldom seen during the day. It feeds mostly on mice, rabbits, birds, young deer, and carrion. The range of the bobcat is the inaccessible mountain areas and the central swamps, though they are occasionally seen elsewhere.

8. The black bear (*Ursus americana*), is probably one of our most interesting game animals. It inhabits the deep eastern and south central swampy forests as well as the mountain forests of Western North Carolina.

By nature, bears are shy creatures of solitary habits and are very seldom seen. Their sight is poor but the senses of smell and hearing are very keenly developed. These animals eat everything that comes to hand. Fruits, nuts, berries, insects, animals, and carrion are included in their diet. They are particularly fond of honey, either wild or domestic and do not mind the stings of wasps or bees obtained while robbing the combs.

Bears do not mate until they are over three years old and the number of young varies from one to four. Young bears are extremely small, practically naked and helpless at birth.

Renegade bears are those that have learned the taste of such farm animals as pigs, sheep and cattle, and it is the individual committing the damage that should be destroyed. Ordinarily bears are not a menace to livestock. They are particularly fond of honey and young corn ears and in some sections of the state their damage to these crops may be considerable.

Most states including North Carolina, have wisely enacted laws prohibiting the setting of steel traps for bears. The regulation of kill and other protective measures should assure a harvestable supply of this fine game animal for our citizens.

E. RODENTS (ORDER RODENTIA)

This is the largest single order of mammals.

The teeth of rodents are adapted for gnawing. There is a single pair of long, chisel-like, incisor teeth in each jaw. The upper and lower incisors are placed opposite each other. As the rodents gnaw hard objects, parts of the teeth are worn away and the sharp cutting

edge is constantly maintained by the growth of the teeth at the base. Back of the incisor teeth are the molars adapted for grinding.

The feet of rodents display several adaptations. The ground squirrel, woodchuck, and chipmunk have feet adapted for digging. Chipmunks are also skillful climbers. The fox squirrel and gray squirrel have sharp claws for climbing. The beaver and muskrat have webbed feet for swimming. The otter actually not a rodent, also has webbed feet.

Some rodents, including the red and fox squirrel, have pouches in their cheeks for carrying food.

1. The beaver (*Castor canadensis*), is the largest of North American rodents. It may attain a maximum total length of 43 inches, and a weight as great as 80 pounds. The average size, however, is much smaller.

The beaver has a broad, flat, scaly tail. The hind feet are webbed. Beavers build their homes of sticks and mud with the entrance under water. They frequently build dams across streams to impound a supply of water. The dam is made of sticks and logs and mud. Beavers live in colonies and establish new colonies as their numbers increase.

The young are born from April to May, sometimes in late March. The average number of young is 4 a litter. The young remain with their parents two years and then mate. Beavers apparently mate for life.

In this state the beaver became extinct, but has since been restocked and is now increasing under protection and improved habitat conditions.

2. The muskrat (*Ondatra zibethica*), ranks first among the furbearers on the basis of the number caught annually in North Carolina as well as in the United States. The muskrat is also the most prolific of the fur animals; 15 to 20 young a year is a fair average for a pair of muskrats. There are commonly 2 or 3 litters a year.

The length of an adult muskrat is about 24 inches. The tail is long and hairless. A thick layer of fine fur is next to the body covered by an outer layer of coarse guardhairs. These two layers together are almost impervious to water. Muskrats live in bank burrows. In swamps or ponds they frequently build mound-shaped lodges of sticks and mud. Entrances and exits to dens and houses are usually under the surface of the water.

The population of muskrats has declined seriously since 1930.

3. The fox squirrel (*Sciurus niger*), and gray squirrel (*Sciurus carolinensis*), are the only squirrels important as game in North Carolina. Both are present in almost every county. Gray squirrels prefer bottom lands with heavy timber and are generally abundant throughout the state. The fox squirrel is most common in south central North Carolina and in other parts of the state where farmlands and open woods predominate. Fox squirrels have 2 litters a year, with 2 to 4 young a litter. Gray squirrels have one or more litters of 3 to 5 young each year.

The squirrels build summer nests of leaves in trees and winter dens in hollow trees. Their food consists chiefly of nuts, grains, and buds.

4. The small red squirrel (*Tamiasciurus hudsonicus*), is found in the western counties of North Carolina. The nests are usually built in hollow trees or abandoned woodpecker holes.

The red squirrel's small size, white breast, and dark rusty red back, as well as his noisy scolding chatter, readily identify him. He is capable of destroying birds nests, eggs, and young if such a taste is developed, or he can live peacefully with his neighbors.

About 4 or 5 young are born in the late spring and are ready to follow the mother a few weeks after birth when she gives them food-hunting and tree-climbing lessons. Occasionally two litters are born in one year.

The red squirrels are generally considered as an important buffer species in many of the northern states and probably serve in the same way as food for owls, foxes, and other predators in North Carolina. They are seldom hunted for food or sport.

5. The woodchuck (*Marmota monax*), is a member of the squirrel family and is commonly known as the ground hog. It is one of the very few North American mammals which really hibernates, and its hibernation has become the basis of the "ground-hog day" superstition in February. The woodchuck hibernates for only short periods and may be seen even during the winter months.

Woodchucks vary in body length from 22 to 27 inches. The body color varies from grayish-brown to reddish-brown, and the intermixture of hairs of different colors gives the animal a grizzled appearance. Woodchucks live in burrows, in rockpiles, or in woodpiles. They are vegetarians and at times may do some harm to farm crops, though the damage is seldom serious.

6. Rats may be divided into two general groups: (1) native rats and (2) introduced rats.

a. The woodrat (*Neotoma floridana*), is one of the less common of our native rats. It resembles the introduced Norway rat in size and general body shape, (differing most conspicuously in the fact that the woodrat has a hairy tail and a sleeker, finer appearance with whiter underparts). However, unlike its imported cousin, the woodrat is not destructive. Its food consists of green vegetation, seeds, nuts, roots, fruit, bark, fungi, and wild bulbs. In mild climates the woodrat bears several litters a year, each with 3 to 6 young.

The native rats are of neutral importance and may be beneficial. They should not be condemned because of their resemblance to the destructive Norway rat.

b. The cotton rat (*Sigmodon hispidus*), is found from Virginia to Florida and its range extends west from Florida to Louisiana. These rats frequent hedgerows and weed fields where the ground cover is dense enough to permit protected access to foods and water. Burrows are dug underground where nests are made.

This small rat has a serious effect on our quail population as it is particularly fond of the eggs of quail and other ground-nesting birds. It competes with quail for food as it eats over 30 types of foods which are preferred by the bobwhite.

Whereas the cotton rat is not as prolific as many other species, it often produces more than one litter a year and where the concentration becomes very dense, many additional predatory species, such as hawks, owls, foxes, and others, become attracted to the area. If the rat population is greatly reduced, these predators turn to game and other species for food.

Where necessary and possible, controlled burning of weed fields, ditch banks, and thickets has a limiting effect on the cotton rat.

c. The Norway rat (*Rattus norvegicus*), was introduced from Europe, and is universally rated as a pest because of its destructive habits and relation to the transmission of disease. The species breeds very rapidly and is readily adaptable to varying conditions; therefore, it is difficult to control. It is important to remember that one factor in the increase of the rat population has been the destruction of flesh-eaters such as foxes, weasels, owls,

hawks, snakes, and others which normally serve to control this and other pests.

7. Mice also may be divided into two general groups: (1) native mice and (2) introduced mice.

a. Of the several kinds of native mice, the most common are the wood mouse, the white-footed mouse, and the meadow mouse. Their runways may be found in meadows, pastures, or woods. The field mice, particularly the meadow mice, are important for their damage to crops and orchards; however, they serve as food for fur and game mammals.

b. The house mouse (*Mus musculus*), like the Norway rat, has been introduced into the United States.

F. HARES AND RABBITS (ORDER LAGOMORPHA)

1. The cottontail (*Sylvilagus*), is probably the most widely hunted mammal in North Carolina. It is important as game and serves as a source of food for predatory animals and man. The rabbit thus serves as a buffer, or shock absorber, between predators on the one hand and game, poultry, and livestock on the other. Cottontails are very prolific, however, and successfully maintain their numbers in spite of tremendous losses. The average number of young in a litter is four, and there are usually two or three litters a year. Cottontails occupy widely-varying habitats, but in general they prefer field borders which provide tall grass, weeds, and brush for cover. The thickest honeysuckle and blackberry briar tangles are favorite places to hunt for rabbits.

Despite the many thousands of rabbits taken by hunters and predators, plus those killed on the roads by automobiles, the rabbit is capable of holding its own.

Rabbits and squirrels can be bought and sold in many counties of North Carolina, and this practice should stop as there can be no true concept of game as long as it is the subject of commerce. All true sportsmen and nature lovers should exert every effort to halt the damaging commerce in our wildlife.

G. EVEN-HOOFED MAMMALS (ORDER ARTIODACTYLA)

1. The white-tailed deer (*Odocoileus virginianus*), is one of the two representatives of this order among the game mammals of

North Carolina. The 1948-1949 Game Survey indicated that there are about 50,000 deer in North Carolina. Deer are not completely distributed over the state, but are found almost exclusively in the extreme eastern, south central, and western counties.

The deer are one of our most prized game species and are capable of establishing themselves and thriving if they are introduced in areas where the necessary living requirements are present.

Although only the males characteristically carry antlers which are shed each winter, occasionally a female with a set of antlers is killed.

The fawns are born in the spring and do not lose their spotted coats until the next fall. Usually one fawn is born, although twins are common.

Deer feed by browsing on leaves, twigs, buds, berries, mosses, and plants found around woodland borders and quite often farmer's crops such as sweet potatoes, peanuts, and fruit trees suffer from their depredations, particularly when the natural food supply is low or the deer are too abundant.

One peculiarity of deer is that they rarely migrate or travel over a wide area. If the food supply becomes depleted in the home range, the animals will not travel long distances in search of a new supply. Consequently a heavy snow and a prolonged cold period will sometimes find deer dead of starvation while actually only a short distance from a plentiful supply of food.

Self-hunting dogs do damage to a deer herd when the fawns are in the woods and often kill females heavy with young. The practice of hunting deer at night with lights is discouraged as this method of hunting is actually stealing from the law abiding sportsman.

2. The European wild boar (*Sus scrofa*), occurs only in the far western counties of North Carolina, primarily Cherokee, Clay, and Graham. These unusual game animals were originally stocked on a private estate, and it is generally believed that those now roaming the mountainous forests of this area are the descendants of a few which escaped from the private preserve. The litter usually contains 4 or 5 young and as there is not enough information on the breeding habits of these animals, no definite breeding season can be established.

It is believed that everything edible including fruits, nuts, berries, farm crops, birds' eggs, frogs, and roots is consumed by the boars.

When food is scarce in an area, the animals move on to another source of supply.

The wild boar is a ferocious and unpredictable animal when at bay or when wounded, and inflicts heavy damage on the packs of hounds which are used in the chase.

Evidence supports the belief that the original European boars have interbred with native wild hogs which would seem to account for the smaller size of some of the specimens now being taken.

Despite heavy hunting pressure these animals are extending their range and are fast becoming a popular game species. Continued regulation of the kill will be an aid in the further establishment of their population.

V. ACTIVITIES

1. *Examination of fur.* Examine the pelts or fur of several mammals and note: (a) the thickness of the coat, (b) the texture (softness or coarseness) of the fur, (c) the different kinds of fibers, and (d) the length of fibers.

2. *Comparison of fur.* Compare the fur of land mammals, such as rabbit or skunk, with the fur of aquatic mammals, such as the muskrat. How does the fur of the latter protect the body against water?

3. *Examination of teeth.* Examine the teeth of a herbivorous (plant-eating) mammal such as the cow, horse or sheep. How are they adapted for biting and grinding vegetable matter? Examine the teeth of a carnivorous (flesh-eating) animal such as the dog or cat. How do they differ from those of a plant-eater? Examine the teeth of a rodent such as a squirrel or mouse. What are the special adaptations of these teeth?

4. *Comparison of foot structure.* Compare the foot and leg structure of a cat, rabbit, squirrel, mole, bat, and muskrat. For what sort of use is each type of structure best suited?

5. *Kinds of mammals and their habitats in local community.* List the different kinds of mammals found in your local community according to the following groups: furbearers, game and furbearing mammals, destructive rodents, and predators. Which are most abundant? Which are scarce? Which are most often seen in fields and woods? Which are found in and around water? Along fence-rows and field borders? Why do raccoons not live in treeless grass-

land? Why are minks most numerous along woodland streams? Do some habitats contain more mammals than others? Why?

6. *Study of tracks.* Carefully observe the damp soil along creeks or ditches, or along field borders after a rain or snow, and see how many different kinds of tracks you can find. Try to learn what animals made the tracks. What do the tracks and arrangements of tracks indicate about the animals? What other "signs" do mammals leave?

7. *Observation of young mammals.* During the spring and early summer, watch for young rabbits, squirrels, opossums, skunks, etc. Do certain mammals show more activity at night? If so, what kind?

8. *Finding dens.* Look for dens along banks of streams or ditches, in pasturelands, under tree roots, and in rock ledges. When you find a den, note (a) whether it has more than one entrance, (b) whether a mound of earth is left at the entrance, and (c) the extent to which the den affords protection for the animals which inhabit it. Are there characteristic odors, tracks, scats (droppings), or debris, in and around the entrance of the den? Dens should not be damaged during observation.

9. *Finding den trees.* Visit a piece of woodland and look for large, hollow trees. Examine such trees to learn whether animals are using them. What species inhabit hollow trees? Look for den trees which have been cut by hunters or loggers. Why is the cutting of such trees a serious matter? Look for leaf and twig nests. What uses these?

10. *Inquiries about animal population trends.* Ask someone who trapped ten or fifteen years ago how the numbers of furbearing animals of that time compare with those at present. Make similar inquiries about population trends of field mice, rats, rabbits, and squirrels. Are some species of mice more abundant at certain seasons of the year?

11. *Depredations on poultry and livestock.* Ask several farmers whether they have lost poultry through the activities of minks, weasels, skunks, opossums, foxes, or other mammals. Find out whether dogs have recently killed sheep or other livestock in your community. How do predatory animals help the farmer to offset the damage from predation?

12. *Damage by rodents.* Ask farmers to describe the amount of damage done to grain fields and stored grain by mice and rats.

Ask owners of orchards how much damage is done by rabbits or mice. Observe the burrowing of moles in gardens and fields. Do moles eat vegetables or bulbs? Find out what methods are used to control rodents.

13. *Study of habitats.* Look over the land of your community to learn whether it constitutes a favorable habitat for wildlife. Is there much wooded or brushy land? Are there any permanent ponds, lakes, creeks, or rivers? Are there any swamps? Are there any large areas covered with tall grass or weeds? Are the habitats arranged in checkerboard fashion or are they in solid blocks? Which arrangement is best for a wide variety of animals?

14. *Effect of clearing.* If your community has land from which all the timber has been cut within the last twenty years, ask hunters and trappers who have lived in the community during that period whether the clearing has affected the supply of wildlife. Visit a woodlot border that has not been cleared. Look for paths, tracks, and other signs of the presence of small mammals.

15. *Intensive farming.* If some of the land of your community is farmed intensively—i.e., with practically all of the available space devoted to crops—find out what kinds of mammals are present and whether they are numerous or scarce.

16. *Drainage.* Find out whether there has been any drainage of swamps, marshes, or lakes, or straightening of stream channels. How has the drainage affected the wildlife population of the region?

17. *Burning of woods and fields.* Find out whether the burning makes the surroundings less favorable for wildlife. At what time of year would burning be most harmful to wildlife? Collect soil samples from a field or wood which has recently been burned. Compare these samples with soil taken from a woodland in which there has been no fire. Which samples have the more organic matter?

18. *Overgrazing.* Visit pasture land that has been very closely grazed for several years. Look for dens or other signs of wildlife. How is overgrazing related to the problem of conserving soil, water, and forests?

19. *Study of trapping methods.* Read any available material which describes efficient methods of trapping. Ask trappers and hunters to explain the methods used in catching the various species. Find out how furs are lost or ruined by poor methods. Are there

more humane methods of trapping than by the use of steel traps? How are the mammals caught alive and uninjured?

20. *Examination of pelts.* Ask a hunter to show you a collection of pelts and to explain methods of skinning and caring for pelts. Gently pull the fur of a pelt; if it is prime the fur is firmly set in the skin and is not easily pulled out. At what season do most fur animals prime?

21. *Value of local fur catch.* Interview local hunters and trappers to learn (a) approximately how many animals of each species are caught each year, and (b) the approximate cash value of the furs. Find out whether the value of the annual catch is increasing or decreasing.

22. *Study of fur garments.* Visit a store and examine some fur garments. Find out what kinds of animals produced the furs, and what furs are the most expensive. Learn whether the furs were produced in the United States or imported, and how fur garments should be cared for.

23. *Prices and grades of fur.* Write for several fur-buyers' catalogs and price lists. What are the different grades of fur? How do the various species compare as to price?

24. *Game Code.* Secure a copy of the North Carolina Game Code from the North Carolina Wildlife Resources Commission or your County Fish and Game Protector. Learn the regulations relating to the hunting and trapping of mammals common in your community.



Mink, a valuable furbearer.



Banding birds gives scientists important information about the routes birds travel in migration as well as many valuable facts which help determine hunting regulations on game birds.

Mr. Bob White, our most popular game bird.

Photo Courtesy U.S. Fish & Wildlife Service



Lespedeza bicolor provides food and cover for wildlife and helps the farmer in many ways.



BIRDS



Canada geese, Hyde County is their favorite wintering area.

VI. FACTORS IN THE CONSERVATION OF BIRD LIFE

A. FOOD. COVER. WATER. WEATHER

1. The three essentials in the surroundings of birds are food, cover, and water. If these three are present in proper form, and close enough together to be used together, they tend to reduce to a minimum the destruction of birds by natural enemies or severe weather.

2. All three of these must be present throughout the year. A shortage of any one of them for even one season results in a heavy loss.

3. The seasons of greatest loss due to environment are the spring and the late winter. In the spring, eggs, nests, and young birds are especially vulnerable to storms, predation, floods, and other natural factors. In the late winter, both food and cover may be scant when the most severe weather occurs.

4. The destruction of natural food and cover, together with

increased hunting pressure, has been the most important causes of the reduction of North Carolina's bird population. The clearing of forests, the plowing of native grasslands, and the production of cultivated crops have been necessary, but they have destroyed large areas of food and cover once used by wildlife.

5. Extremely clean farming, in which all fencerows are cleaned and all weeds and brush removed, destroys much of the food and cover that could have been used by useful and ornamental game and songbirds.

6. Drainage, however necessary it may have been from the agricultural standpoint, has destroyed the home of many thousands of waterfowl, marsh birds and shore birds.

7. The burning of fields, field borders, and woods is often fatal to the eggs and young of ground-nesting birds.

8. The sudden rises of streams that drain from bare land and the loads of silt that they carry have done much to destroy the food and nest-sites of water-dwelling birds. The summer drying of streams that used to run throughout the year has had the same effect. Both of these are results of the loss of soil from the land.

9. Conservation measures:

a. Produce food and cover for birds on the lands that are not used for crops. These include field borders, woodland clearings, gullies, plant beds, and the land about buildings. Birds are found most around edges of fields, streams, ponds, roadsides, and other vegetated areas.

b. Aid and protect birds as much as possible in the nesting season by the use of nesting boxes, bird baths, flushing bars when mowing, and by controlling wild fires.

c. Feed birds as much as possible in winter by setting up feeding stations and shelters or, even better, by planting food patches of sorghum, lespedeza, or other grains along field borders.

d. Where food is present without cover, or cover without food, or both without water, try to supply the missing element so that the birds can have all three without having to cross large open spaces and expose themselves to danger.

e. Avoid burning or overgrazing the woods, and leave the hollow trees. Birds will more than repay the kindness in protection against insect-pests.

f. Plant the banks of ponds to grasses, shrubs, and water

plants, thereby making them safer for wildlife and protecting them against erosion.

B. NATURAL ENEMIES

1. In North Carolina the stray house cat is the principal natural enemy of birds, doing its most serious damage during the nesting season. Not only stray cats which have to shift for themselves, but also pet cats that are allowed to roam at night contribute to the killing of an estimated 6,000,000 birds each year in this state.

2. Self-hunting dogs destroy a large number of ground-nests and young birds.

3. Snakes destroy many eggs and young birds. On the other hand, they are important destroyers of harmful rodents and insects. Except for the poisonous snakes—which in this state include only the rattlesnake, copperhead, coral snake, and cottonmouth or water moccasin—and except for snakes caught in the act of robbing nests, they should be left alone because of other beneficial services they render.

4. Skunks, squirrels, and other animals also destroy eggs and young birds at times but this destruction is not serious and nearly every one of these animals has its own value in another way. Hence, it is not very safe to condemn any one of them and start extermination measures for fear of upsetting some important natural balance.

5. Predatory birds, like a few of the hawks and owls, were discussed in a previous section of the bulletin. Their effect upon the bird population, with the exception of the blue darters and the great horned owl, is negligible. This fact has been amply shown by the thousands of stomach-analyses made by federal biologists and others.

6. Parasites and diseases affect wild birds, but so little is known about them at present that little can be done to prevent them.

7. Conservation measures:

a. Keep pets and hunting dogs under control, especially during the nesting season.

b. Pay little attention under normal conditions to the other animal enemies of birds. Predators constitute one of Nature's ways of removing the weak, diseased, crippled, stupid, and otherwise unfit animals, leaving the more fit to perpetuate the race. Sometimes, in certain areas, a particular predator may be-

come too abundant. It should be controlled, but careful thought should be given to any such problem.

C. HUNTING OF BIRDS

1. Hunting, at times, has been a factor in exterminating game, but there is a difference between reasonable hunting which takes only a surplus crop and overhunting which makes no provision for the future.

2. The reasons why there is no biological harm in taking a crop of game birds, provided ample seed-stock is left, have been given earlier in this bulletin.

3. Conservation measures:

a. There is no reason, from the standpoint of the birds, to forbid hunting, but we should endeavor to leave enough birds to provide seed-stock for the next spring.

b. We should try to determine what surplus can be taken safely and then not permit the taking of more than that.

D. OTHER FACTORS

1. More birds, except perhaps game species, are killed by storms, by starvation, and by accidents during migration than in any other way. We can help to counteract this loss by improving the surroundings of those birds which we are in a position to assist.

2. Millions of sea-birds and waterfowl were killed by oil dumped on the surface of the ocean from ships until this practice was outlawed by international treaty. The oil-film coated the feathers and made it impossible for the birds to rise from the water.

3. Collectors of ornamental plumes and other parts of birds for the millinery trade almost exterminated the egret and certain other species until this commercial activity was stopped by federal law in 1913. In 1940, a further agreement was reached between the feather trade, the federal government, and the National Audubon Society by which no more feathers and parts of wild birds, even from other countries, would be purchased and all present stocks would be disposed of within six years.

4. Birds, especially slow fliers like the red-headed woodpecker, are frequently seen dead along the highways. The number is considerable but probably insignificant in the country as a whole. In some places the highway loss is being reduced by planting shrubs

and other plants used as food and cover along the rights-of-way. This practice may increase the loss by causing more birds to frequent highway areas.

5. The building of cities reduced the numbers of many birds that formerly lived in those areas but provided suitable habitat for other species such as sparrows, starlings, and pigeons. With the development of trees, ornamental shrubbery, gardens, and other attractions around homes, along streets, and in parks, more and more birds are finding it possible to live in and pass through even the largest cities.

VII. THE IMPORTANCE OF BIRDS

A. DESTRUCTION OF INSECTS

1. Birds have an enormous capacity for insects. Their body-processes go on rapidly and their bodies require large amounts of fuel, so they feed almost constantly. The crop of one nighthawk was found to contain 3,000 mosquitoes, and nearly 2,000 were found in one martin; other such cases are very common.

2. Birds ordinarily take whatever insects are most abundant at the time. This habit is especially useful, because large gatherings of grasshoppers, army worms, web worms, and other pests cause most of the insect damage to crops and orchards. There are examples, too numerous to mention, of masses of injurious insects that have been cleaned out by gatherings of insectivorous birds which were attracted by the concentration of food. An excellent example is the destruction of the hordes of grasshoppers in Utah by a flock of gulls which previously had not been known to visit that state.

3. Birds eat insects wherever the latter appear: in the air (swifts, swallows, flycatchers, goatsuckers, etc.); or in or on tree trunks and large branches (woodpeckers, nuthatches, creepers, etc.); or in or on the ground (fowls, sparrows, meadowlarks, shrikes, etc.); or in foliage (warblers, vireos, sparrows, finches, thrushes, etc.). There is no place visited by insects that is not also visited by some birds.

4. Thus birds contribute greatly to the control of harmful insects, the damage by which has been estimated to be as high as one billion dollars a year.

5. Birds are not, however, the only means of controlling harm-

ful insects. The common belief that insects would destroy all vegetation and make the earth uninhabitable in a few years if it were not for the birds is probably not based upon fact. Insects, like all animals, are limited in numbers by food supply, natural enemies, and climate; and birds are not their only natural enemies. Insects prey on each other and spiders and similar insects play an equally important, or even more important part. A bird which eats beneficial insects and spiders is removing some the the enemies of harmful insects.

On the other hand, birds are larger than insects; they eat more; they move about more, coming in contact with larger invasions of insects; and they eat a greater variety of insects than preying insects do. While not all important, birds are very important in maintaining the present balance of nature; therefore, protecting and encouraging them is abundantly justified.

B. DESTRUCTION OF WEED SEEDS

1. Much the same reasoning as in the preceding paragraphs can be applied to the relations between birds and weed seeds. They are important controllers of overabundance, though they are not the only destroyers of weed seeds.

2. Their capacity for seeds is as great as their capacity for insects. The stomach of one bird contained 10,000 seeds, taken in a single day; and it has been estimated that the native tree sparrows of one midwestern state consumed 875 tons of weed seeds in a single winter.

3. The sparrows, finches, game birds, and others of their kind, are the principal seed eaters, but most of the insectivorous birds which remain in North Carolina through the winter transfer their attention to seeds until the insects again become abundant in the spring.

C. DESTRUCTION OF CROPS AND FRUITS

1. Some birds cause considerable damage to small fruits like grapes and cherries, but this problem is usually local and does not change the value of the birds on a year-round basis. Measures for preventing this damage can be learned from other sources.

2. Where certain birds have become so numerous as to destroy

whole crops, as in some parts of California, control measures have had to be undertaken.

D. AS PREDATORS AND SCAVENGERS

1. Where individual predatory birds destroy property, they must be destroyed.

2. Almost everywhere and almost all of the time, however, the predatory birds (hawks and owls) are distinctly valuable as killers of crop-destroying rodents and the larger insects such as grasshoppers.

3. Only two kinds of hawks (Cooper's and sharp-shinned hawks) are unprotected in North Carolina. They can be killed by anyone at any time, because their diet contains a large proportion of other birds. The Cooper's and sharp-shinned hawks are commonly known as blue darters and are fairly common. The goshawk almost never occurs in North Carolina. The killing of other hawks, except when caught in the act of destroying property, is forbidden by state law; most states protect these valuable birds. Other birds not protected and which can be taken at any time are the great horned owl, the crow, the starling, and the English sparrow.

4. It would be wise for the reader to learn to distinguish between the different kinds of predatory birds. Also it would be well for them to learn to distinguish between the misbehavior of occasional hawks and owls and the great value which nearly all of them have to man.

5. Scavengers, like the turkey buzzard, (more properly, turkey vulture), crow, and bald eagle consume decaying animal matter. The crow has some bad habits and is outlawed in North Carolina, but the other scavengers should be protected. The bald eagle is now specifically protected by both State and Federal law.

6. In North Carolina, the Wildlife Resources Commission is the agency charged with the duty of protecting birds. Although the money which enables the Commission to carry on its work comes mostly from hunting and fishing licenses or permits, the Commission is concerned with protection of all forms of wildlife and does not limit its protection to game birds only. Its plan of handling game birds is to regulate the number taken by hunting so as to preserve permanently an adequate breeding stock.

E. RECREATIONAL, EDUCATIONAL, AND ESTHETIC VALUES

1. The value of birds in adding to the enjoyment of campers, vacationists, and all other users of the outdoors needs no further comment.

2. The game birds in North Carolina at present are the rails, ducks and geese, wild turkeys, quail, doves, and grouse. Their hunting is governed by state and federal laws and is restricted so as to insure the preservation of an adequate breeding stock for the next year.

3. North Carolina now has about 200,000 licensed hunters, plus a large number of others for whom licenses are not required by law. Farmers and farm boys do not have to have a license to hunt on their own lands.

VIII. STRUCTURE AND ADAPTATIONS OF BIRDS

Birds have many distinct characteristics which fit them to live under special conditions. Adaptations are such characteristics. Sometimes adaptations are structural, as the webbed feet of some water birds (ducks) or the strong talons of predatory birds (hawks). Sometimes they are functional or physiological, as the high temperature of the body. Naturally many of them are associated with the bird's power of flight, but there are also many others. A short account of the general structure of a bird and of some of the more conspicuous adaptations which the reader should notice is given on the following page.

A. EXTERNAL STRUCTURE

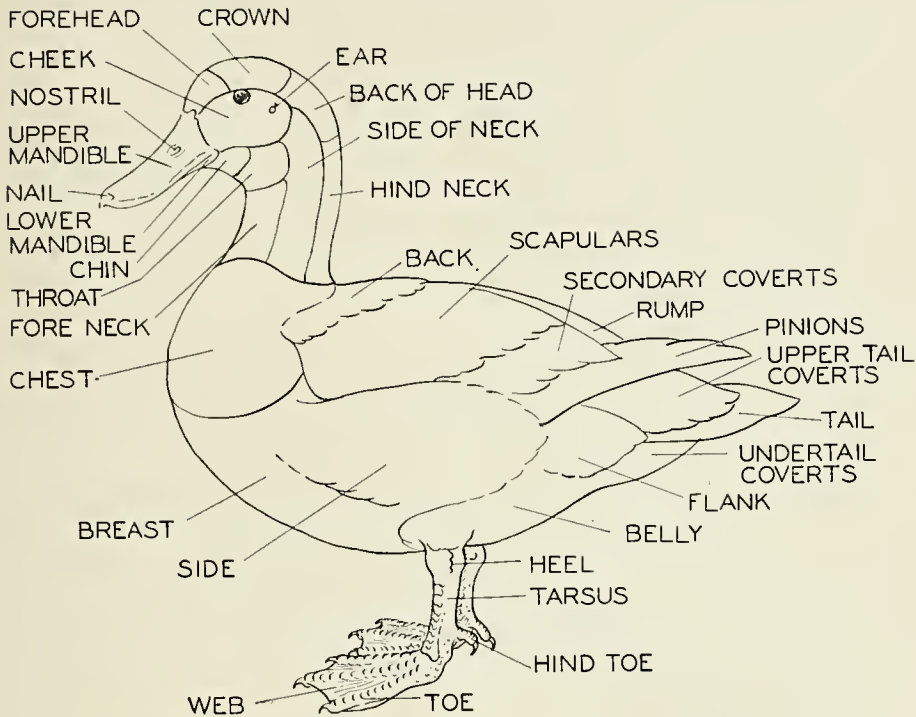


Diagram showing the principal external parts of a wild duck.

B. ADAPTATIONS

1. Flight adaptations are made possible by (a) feather structure, (b) lightness and streamlining of the body, and (c) the development of the forelimbs into wings.

a. The principal types of feathers are four in number: *Contour feathers* are the exposed body feathers and have overlapping vanes (the strong, flat part of the feather) with downy filaments at the base. *Flight feathers* are very large contour feathers with little or no down. Down feathers are soft and have no vanes; they form the feather layer next to the skin, and by holding a layer of small air pockets about the body, help to conserve body heat. *Thread feathers* (filoplumes) have long, hair-like shafters with no vanes and few or no downy filaments; they remain on the body after the other feathers have been removed by plucking. The vane of a flight feather or a contour feather is composed of small threads (barbs) extending out

from the shaft; these barbs are held closely together by tiny hooks, which can be seen by aid of a magnifying glass, and in this way they do not permit the passage of air through the feather.

b. The bones of a bird are light and the skeleton is very compactly built. Some of the larger bones are hollow, such as those of the thigh, upper wing, and breast. These bones sometimes contain air sacs extending out from the lungs. This arrangement makes the bones lighter and increases the surface through which breathing takes place.

The body is streamlined; it tapers from front to back and from head to belly. Such a shape reduces wind resistance when the bird is in flight. Many important points in the designing of automobiles and airplanes have been taken from the structure of birds.

c. Different kinds of flight are associated with different types of wing structure. Soaring birds like hawks and buzzards have long, broad wings; agile, darting fliers like swallows and chimney swifts have long narrow wings. Some birds, like the flightless penguin, have their wings modified as flippers for "flight" under water.

The wing has most of the bones that are found in the human arm, but those of the wrist and hand are combined into a very few bones.

The large tail feathers of many strong fliers serve as a brake and as both a horizontal and a vertical rudder, as well as for other purposes not related to flight, such as, courting accessories and balancing aids.

2. Perching and grasping adaptations are made possible by the structure of the feet.

a. There are usually four toes on each foot, most commonly three forward and one backward, but sometimes (as in the woodpeckers and parrots) two forward and two backward. Either arrangement enables the bird to grasp a branch or some other object.

b. Strong tendons pass from the leg muscles to the toes. They are so arranged that when a bird settles down on a limb the toes are locked in place, so that the bird may even sleep without losing its balance.

c. Predatory birds, like the hawks and owls, have unusually

strong feet and claws called talons for catching and holding their prey.

3. Food-getting adaptations involve both flight and grasping and also the structure and use of the bill and several other adaptations.

a. Flesh-eating (carnivorous) birds, such as the hawks and owls, have strong, hooked bills for tearing or shredding flesh.

b. Seed eaters, such as the sparrows and the cardinal, have heavy, seed-crushing bills.

c. Insect eaters, such as warblers and vireos, have slender, sharp bills.

d. There are various other types of bills, such as the heavy, sharp chisel of the woodpeckers, the saw-toothed bill of the mergansers (fish ducks), the long bill of the snipe and woodcock used for probing in the mud, and many others.

e. The mouth is unusually large in birds like swallows, swifts, or nighthawks, which catch small insects in the air.

f. The woodpeckers have tongues with back-curved spines which are used to extract grubs from their holes in the bark and wood of trees.

g. Most birds have crops for storing food until it can be digested. The crop is located between the throat and the stomach. It enables the bird to take a comparatively large quantity of food hurriedly and then to carry on digestion continuously.

h. Most birds have gizzards, in which the hard parts of the food are finely ground, with the aid of grit or gravel which is part of their diet.

4. Swimming and diving are aided by adaptations of the feet.

a. Most aquatic birds, such as ducks, geese, pelicans, gulls, loons, and others have webbed feet. In the pelicans and their relatives, the webs are between all four toes; in the others, only between the forward three toes.

b. The grebes and coots have lobes on the toes instead of webs between them.

5. Adaptations in body functions: Birds have a high body temperature. This is a result of the very rapid combustion (oxidation) of food which accompanies the vigorous actions of nearly all birds.

a. Radiation or loss of heat from the body is reduced by the structure of the feathers, with their entrapped layer of air, and

by the fact that the contour feathers shed water so that the skin is never really wet. The liquid from an oil gland (preen-gland) located at the base of the tail is used by birds to coat the feathers which enables them to shed water.

b. The heavy down of the breast is held around the eggs during incubation, thus retaining the heat of the body of the setting bird. Sometimes, for example in some of the ducks, down is plucked out and used to line the nest.

c. The wings are also used to cover the eggs or young at night or during bad weather; thus wings aid in preventing the loss of heat.

IX. THE PRINCIPAL KINDS OF BIRDS

A. CLASSIFICATION

1. Classification of all animals is necessary for the same reason that books in a library or soldiers in an army must be classified into large, then successively smaller groups. The classification of animals is one way of showing their relationships to one another.

2. All birds belong to the large group of animals which have vertebrae or backbones; these are known as the Vertebrates.

3. Within the group of Vertebrates, birds are placed in a class known as *Aves*. They are distinguished from all other vertebrates (fish, amphibians, reptiles, and mammals) because they possess feathers. No other vertebrates have feathers. Birds and mammals are the only warm-blooded animals.

4. The class to which the birds belong (*Aves*) is further subdivided into *Order*, *Families*, *Genera* (singular: *Genus*), and *Species*, just as a Battalion is sub-divided into Companies, Platoons, Squads, and Individuals.

5. Finally, the individual kind of bird is given a name like that of a person. Scientific names are used because they are recognized the world over. Common names vary from place to place. The scientific names of a bird (or of any other animal) usually consists of two parts: The *Genus* or group name like Smith or Jones and the *Species* or individual name like Frank or Mary. Among the Chinese, the generic (family) name comes first, the more specific name second. This plan is used in applying names to animals. Thus the robin is *Turdus migratorius* and the English sparrow *Passer*

domesticus. If we did the same thing with human names in America, we would say Smith John or Jones Frank.

B. PRINCIPAL BIRD GROUPS

1. Water birds include the ducks, geese, swans, pelicans, loons, grebes, coots, gulls, and their relatives. They have webbed or lobed feet and swim expertly. They are also strong fliers and migrate for long distances. Their food includes water plants, water insects, fish and other small water animals; gulls especially are useful scavengers, feeding upon dead animal matter near water.

2. Shore birds and marsh birds include the herons, cranes, rails, snipes, sandpipers, plovers, and their relatives. Most of these birds feed in the shallow waters on water plants, fish, and small water animals. They are adapted to this habitat by having any or all of these features: long bills, long necks, long legs, or large feet.

3. Fowls or gallinaceous birds, include not only domestic poultry but the wild birds related to them, such as quail, wild turkey, pheasants, and ruffed grouse. These birds are mostly ground dwellers, with strong feet for scratching, heavy bills, stout bodies, and short, broad wings for a short rapid flight.

4. Birds of prey include the hawks, eagles, owls, and a few others such as the shrikes. Actually, of course, even a bird that eats a grasshopper is a bird of prey, but the term is commonly applied only to those that kill other vertebrates for their food. These birds are strong fliers, with powerful talons for catching prey and hooked bills for tearing flesh. Almost all of them, however, take a large proportion of insect food, and as a group they are far more beneficial than harmful. This question is discussed later in this bulletin.

5. Woodpeckers and a few other birds like the nuthatches, creepers, and the black-and-white warbler, feed upon insects on or in the trunks and larger branches of trees.

6. Aerial feeders include birds of several groups which feed upon small insects in the air. They have large mouths, long, slender wings for agile flight, and small, weak feet. Examples are the goat-suckers (nighthawks, whippoorwill, etc.), chimney swift, and the various swallows and flycatchers.

7. Warblers, vireos, and many other small birds feed mostly among the leaves and smaller branches of trees, on the insects that live there.

8. Seed eaters include the fowls and many other smaller birds such as the sparrows and finches.

9. General feeders include most birds, even many of those already listed. When insects are abundant, they feed upon insects. When weed seeds are plentiful these are taken, as during the winter. Sometimes these birds eat buds, berries, fruits, or dead animal matter. One of the greatest values of birds is that most of them can eat whatever is most abundant at the time, a point that is discussed below.

X. BIRDS THROUGH THE SEASONS

A. SEASONAL STATUS IN NORTH CAROLINA

The seasonal status of a bird represents the period it spends in North Carolina. On this basis, then, nearly all of the approximately 400 species and sub-species of birds that have been known to occur some time or other in this state can be placed in six groups:

1. Permanent residents remain in the state throughout the year. Examples are the crow, jay, cardinal, quail, and chickadee.

2. Summer residents arrive in the spring, nest in North Carolina, and go South again in the fall. Examples are the orioles, many warblers, goatsuckers, swifts, cuckoos, and hummingbirds.

3. Winter residents arrive in the fall from their more northern breeding grounds, spend the winter in North Carolina, and go north again in the spring. Examples are ducks and geese and other waterfowl.

4. Transient visitors nest north of North Carolina and winter south of this state, and are found here only during the spring and fall migrations. Examples are most of the thrushes (except the wood thrush), most of the ducks, many warblers and sparrows, and most of the shore birds.

5. Summer visitors nest farther south but wander northward into North Carolina after the breeding season. Examples are the wood ibis and some of the herons.

6. Winter visitors ordinarily spend the winter north of North Carolina but in severe winters sometimes move into parts of this state. Examples are the snowy owl, lapland longspur, and the snow bunting.

7. These designations do not necessarily apply to the entire state and must be worked out locally. For instance the song sparrow

is a permanent resident in western North Carolina but only a winter resident in eastern North Carolina.

B. SEASONAL ACTIVITIES OF BIRDS

1. Spring (Mating and Nesting time): This is the season of the arrival of the migrants and is the time for song, courtship, mating, nesting, incubation of the eggs, and care of the young. These activities extend well into the summer, and some birds, like the mourning dove, may continue nesting into the early fall; but the spring is the season when the breeding period begins.

a. Some birds, especially the duller-colored ones, do not change color throughout the year. Most male birds, however, have their most brilliant plumage in the spring and early summer. It is then that they display their greatest powers of song, which is now believed to be a means of warning intruders away from the territory which they have set up for summer.

b. The territory is further defended by fighting, more frequently by the male, but often by both members of the pair. The fighting instinct is so strongly developed at this season that birds have been seen trying to fight with their own reflections in window panes.

c. Birds exhibit many kinds of courting behavior, from the puffing and cooing of pigeons on the barn roof, the strutting and display of the cock pheasant or turkey gobbler, to persistent chasing of the females or the drumming of a grouse in the woods.

d. Once mated, the two sexes generally remain together only for a single breeding period, but some remain for many years, others perhaps for life. The Canada goose and the whistling swan are believed to mate for life. Most birds, however, keep the same mate for one season and then change to another.

e. The male often builds a number of extra nests, as in the case of the house wren, but the female usually takes the lead in constructing the nest that is actually used.

f. Each kind of bird has its own preference as to nest site. Some, like the quail, meadowlark, and towhee, nest on the ground. The Baltimore oriole suspends its nest from the tip of an overhanging branch. Wrens, chickadees, bluebirds, woodpeckers, and many others occupy holes, and it is this group that is most easily attracted to the premises by setting up artificial nesting boxes. Cardinals, thrashers, catbirds, and birds of similar

habit nest in shrubbery; whereas phoebes, robins, and barn swallows prefer the bare sides and shelves of buildings, bridges, or other structures. Nests in high trees, like those of the crested flycatcher and many of the smaller birds, are more difficult to find but are none the less characteristic of the species.

g. The number of eggs laid in a clutch is fairly constant for each kind of bird, varying from the one or two of the mourning dove or whippoorwill to fifteen or more in the nest of a bobwhite quail. Most of our common birds, however, average three to five eggs in a clutch.

h. In some cases both sexes share the duty of incubation; where only one sex incubates, it is almost always the female. The incubation period varies from 10 to 30 days, usually longer for large birds. Most of our common songbirds have an incubation period of about two weeks.

i. In North Carolina there is usually but one brood a season, but many common birds (robin, bluebird, cardinal, chickadee) have two, and some (mourning dove) have three; the English sparrow may have even more.

j. Young birds are of two kinds Precocial young when hatched, are well feathered and ready to leave the nest almost at once; examples are the fowls, ducks, and plovers. Altricial young are nearly naked and quite helpless when hatched; they must be fed and brooded by the parents for a week or two before they are ready to leave the nest; examples are doves, hawks, and all of the songbirds.

2. Summer (Rearing and Moulting time): During this season with few exceptions the rearing of young is completed before the quiet period during which moulting or shedding of the feathers takes place.

a. After the young birds leave the nest, they may or may not continue to associate with their parents. Quail remain together as a family group until the fall shuffle which splits and recombines family groups into winter coveys. Among robins, blackbirds, and many other species, the young may return each night to roost near their parents. Among other birds, however, the young wander about by themselves or in flocks with the young of other families.

b. The late-summer moult, in which the plumage is changed to the fall coat, begins about mid-July. During the

moulting period birds are much quieter than before, and a patch of woodland that was formerly alive with singing birds will now be almost silent.

c. During August, and occasionally even earlier, appear the first migrants from the North. Some flycatchers, warblers, waterfowl, shore birds, and others, having completed their nesting, are on their way South for the winter.

3. Fall: The southward migration is most conspicuous in this season. It involves the departure of the summer residents, the arrival of the winter residents, and the passage of the transient visitors through the state. It is far different from the spring migration. Instead of brightly-colored, active birds, many of them in full song, we find duller-colored birds, usually silent except for faint call notes. They are secretive and shy. There are just as many, but only the close observer sees many of them. True, there are migrating flocks—blackbirds, waterfowl, hawks, nighthawks, and others—but most birds slip away or pass through unobserved. They are moving to their winter homes. Many species of birds prefer to travel at night. There are accurate accounts of birds flying against the windows of our tallest office buildings on dark nights. The birds may have been attracted by bright lights or merely failed to see the obstacle in their path. Only those persons who have heard the music of a flight of wild geese or swans on their way through the night can appreciate one of the great beauties of migration.

4. Winter: This is the most adverse season for bird life. All through the winter the bird must keep alive, feed, and store up energy for the next breeding season. There are fewer hours of daylight; so birds must feed actively whenever they can. Anything that man does to increase the amount of food during this period helps more birds to survive unfavorable conditions. Although it is not true that a well-fed bird never freezes, it is certainly true that a well-fed bird is much less likely to freeze. Winter is also the period of natural selection—when the less fit individuals die and only the fittest survive. Winter care of birds saves brood stock for next year's production.

5. Seasons and the kill of game birds by man: Under ordinary circumstances, a larger number of birds is produced each breeding season than can survive throughout the winter. There is a yearly surplus which is lost before the next breeding season. In the case

of some larger birds, which breed rapidly and possess game qualities, some of this annual surplus is taken by man, just as the farmer or stockman harvests his surplus corn or hogs, but keeps a breeding stock for the next year. This harvesting should not be done in the spring or summer, because then the birds are nesting and caring for their young. In the fall and winter, however, surpluses have been built up and may be harvested provided that an adequate breeding stock is left for spring. If such a stock is left, man is taking birds that would have been killed by the forces of Nature, and biologically no harm is done to the species. Hunting must be limited, however, by the necessity for preserving the seedstock and by the amount of surplus that can be taken safely.

XI. BIRD STUDY

To the average person, most instruction about birds is meaningless unless he knows some of the birds himself at first-hand. Knowing them does not mean merely attaching names to them. It also means becoming acquainted with their habits throughout the year, learning what factors affect them favorably and adversely, and knowing what can be done to encourage the former and reduce the latter.

There are few natural history subjects in which the average person shows so much spontaneous interest as in birds, even without the aid of a teacher. This interest should be encouraged as much as possible by actual trips into the field and by attracting birds to the home and the school.

XII. OFFICIAL STATE BIRDS OF THE UNITED STATES

Each of the 48 states and the district of Columbia now has designated some native bird as its State Bird. The list follows:

Alabama	Yellowhammer
Arizona	Cactus Wren
Arkansas	Mockingbird
California	California Valley Quail
Colorado	Lark Bunting
Connecticut	Robin
Delaware	Blue Hen Chicken

District of Columbia	Wood Thrush
Florida	Mockingbird
Georgia	Brown Thrasher
Idaho	Mountain Bluebird
Illinois	Cardinal
Indiana	Cardinal
Iowa	Goldfinch
Kansas	Western Meadowlark
Kentucky	Cardinal
Louisiana	Brown Pelican
Maine	Black-capped Chickadee
Maryland	Baltimore Oriole
Massachusetts	Black-capped Chickadee
Michigan	Robin
Minnesota	Goldfinch
Mississippi	Mockingbird
Missouri	Bluebird
Montana	Western Meadowlark
Nebraska	Western Meadowlark
Nevada	Mountain Bluebird
New Hampshire	Purple Finch
New Jersey	Goldfinch
New Mexico	Road Runner
New York	Bluebird
North Carolina	Cardinal
North Dakota	Western Meadowlark
Ohio	Cardinal
Oklahoma	Bobwhite
Oregon	Western Meadowlark
Pennsylvania	Bobwhite
Rhode Island	Ruffed Grouse
South Carolina	Mockingbird
South Dakota	Ring-necked Pheasant
Tennessee	Mockingbird
Texas	Mockingbird
Utah	California Gull
Vermont	Hermit Thrush
Virginia	Robin
Washington	Willow Goldfinch
West Virginia	Tufted Titmouse

Wisconsin	Robin
Wyoming	Western Meadowlark
United States of America	Bald Eagle

XIII. ACTIVITIES

1. *Structure of a bird*: Secure a chicken or some other dead bird. Identify the parts indicated by the diagram on page 49.

Examine the different kinds of feathers. Split the vane of a flight feather apart; do the parts stick together again? Explain, after examining under a strong lens or microscope. How does the connection between the barbs make the feather more useful for its special purpose? Examine the crop, the gizzard, and some of the bones, learning their special adaptations.

2. *Flight habits*: Watch the flight of a hawk, a swallow, and a meadowlark. Explain the body-structure and food habits that are associated with each type of flight.

3. *Nest building*: Watch the nest-building activities of some birds. What materials are used? How much time is required for completion of the nest?

4. *Feeding of the young*: Watch some birds feeding their young. What sorts of food are brought? How often do the parents bring food? Do both parents bring food?

5. *Migrating flocks*: Observe some migrating flocks of ducks, geese, or other birds. Note the kind of formation used, and in general the height and speed. Some idea of the speed of birds' flight can be obtained by measuring with the speedometer the speed of a bird flying parallel to an automobile.

6. *Migration records*: Begin a chart showing the records of migration in your community. Summer residents should have the first date in the spring, the last in the fall; winter birds just the opposite; transient visitors should have first and last dates in both the spring and the fall. With this activity compile a list of local birds, with the seasonal status of each.

7. *Insect damage*: Find out what insects cause the most damage to crops and orchards in your community. What birds are helpful in controlling these insects?

8. *Bird regulations*: From the game laws, which may be obtained free from the N. C. Wildlife Resources Commission, learn what birds can be killed legally, when, and by whom they

may be killed. What citizens of the state are required to have licenses to hunt? What are the open season and bag limits? Why are such regulations necessary? Consult your local game protector.

9. *Food and cover*: Look over the land in your community and talk with your neighbors. Does it seem as though there is adequate food and cover for quail, songbirds, and others? Are the areas of food and cover close enough together to be used? What could be done to improve conditions?

10. *Comparison of habitats*: Visit an area where there are no trees or heavy brush, then another which has a good growth of trees and underbrush. In which area are there more birds? Is the difference due only to the trees, or are there other causes?

11. *Water supply*: Create a water supply near an area where there are weeds, brush, and other good food and cover for birds. This can be done by building earth dams across small ditches, scooping out catch basins for drainage-water, digging out springs or seeps, or in other ways. Watch the birds of this area; do they use this supply of water? Do other birds come from other areas?

12. *Clean farming*: Find a very clean farm in your community, where very little vegetation is left around field borders. Find another which has many brushy or grassy borders. Which farm has more birds? Why?

13. *Bird houses*: Make some bird houses as class and individual projects; houses for wrens and bluebirds are the best to start with. Directions for construction may be found in several bird publications. Set them out some time before the birds arrive. Keep English sparrows and starlings out of the bluebird houses. How many are occupied? Follow these families through the season. Later on, a more ambitious group project would be to build and erect a martin house on the school grounds.

14. *Bird baths*: Erect a bird bath of some sort, even if it is only a shallow pan of water on a stump or other solid base. (Make it impossible for cats to reach the bath, and the birds will use it more freely.) Keep it out all year; birds need water in the winter as well as in warmer weather. How many birds use the bath?

15. *Feeding stations*: Make a feeding shelf or table outside your home or in the school yard. Keep suet and a variety of other foods—grains, green food, nuts, and other foods throughout the year. How many kinds of birds use the feeder, and what foods do they seem to prefer?

16. *Shelters*: In some protected place, build a shelter of brush, or other native materials. This is especially useful to birds in the winter, so complete it before Christmas and visit it regularly, keeping food on hand. What birds use it?

17. *Supplementary food*: Where there is good brushy cover but apparently little food, sow lespedeza or plant some sorghum. Are there more birds after both food and cover are available close together than there were before?

18. *Predatory animals*: Report to the class whenever a cat, snake, hawk, or other predator has been seen to catch a bird. Report also when these predators catch other animals, such as grasshoppers or small rodents.

19. *Local list*: Using a check-list of North Carolina birds, compile a list of local birds (see also Activity 6). Many birds will be absent from your local list; when is this so?

20. *Stalking birds*: Practice approaching birds until you can come close enough for detailed observation. What birds seem easiest to approach?

21. *Use of field glasses*: If you can get a pair of binoculars or opera glasses, or even a small telescope, practice focusing until you can get a clear view of a bird, stationary and in flight.

22. *Abundance of birds*: Which birds in your community are most abundant and which are most uncommon? Can you find any good reasons for the difference?

23. *Trip list*: Count the different kinds of birds seen on the way to school, on a class trip, or during a day in the field. At what time of day, and at what season of the year do you find the most?

24. *Songs and calls*: Listen to the songs and calls of a few familiar birds until you can associate each bird with the characteristic sounds which it makes. Try to describe these sounds to others; do not necessarily try to imitate them, though you can easily imitate some.

25. *Collection of pictures, etc.*: Start a collection of pictures, clippings, and other interesting material about birds.

26. *Types of habitat*: Visit each of the following and record the kinds of birds found: Open fields, woodland borders, timber and brushy land, weedy and brushy fencerows, swamps or marshes.



Research is a most important phase of a stream management program, as conditions must be studied in order to learn what corrections are necessary.



Only clear pure waters will produce trout like these. Unpolluted waters are vital to wildlife.

FISH



A fine eastern North Carolina bluegill.

XIV. FACTORS IN THE CONSERVATION OF FISH

A. CONSERVATION PROBLEM

Most of the streams of North America originally teemed with fishes of many kinds. This was before the white men came with plow and axe and fire to transform a wilderness into an industrial and agricultural commonwealth. To the pioneers who established each new western frontier, such words as erosion and pollution were foreign or unknown. As the human population increased, forests were cleared, land was brought under cultivation, and swamps were drained. Cities sprang up along the larger streams, depositing sewage and industrial wastes into the once pure water. Mine drainage added to the pollution. The water table gradually sank, drying wells and impairing the regularity of stream flow. Silt from the eroded land accumulated in stream channels, reducing the water-carrying capacity and creating conditions unfavorable to the better fishes. On the whole, these factors have had far more influence than the activities of fishermen in depleting the supply

of fish, even though it is understood that excessive fishing may destroy the breeding reserve when environmental conditions are unsatisfactory.

One of the basic problems in the conservation of fish is essentially the same as that involved in the conservation and restoration of all other wildlife—improvement of the habitat. The only way to conserve permanently the fish population of any body of water is to maintain conditions favorable to growth and reproduction. The method may be to increase plant growth and food supply in and along the water; it may be to reduce pollution; it may be to set aside protected areas for the spawning and feeding of young fish; it may require the restriction of fishing. Every broad program of fish conservation and management involves the use of many practices to the end that our waters may remain clean, sightly, and productive.

Three essentials for fresh-water fishes, as for upland wildlife, are food, cover, and water. The food of young fishes consists of water insects, crustaceans, other small animals, and, to a limited extent, aquatic plants. Adult fish of most species are predatory, feeding mainly upon small fish; this fact adds to the complexity of the problem. To meet the requirements of a satisfactory fish habitat, a body of water must support an adequate growth of organisms which furnish food and cover to large numbers of young fish; also it must have sufficient volume of water and stability of water level to provide a permanent source of food and cover for forage fish as well as for game fish of breeding age.

Probably no other form of wildlife is so utterly dependent upon a balanced environment—a harmonious relationship between soil, land, plants, and stream life. Fish, like other animals, are affected by crowding and the limitations of their surroundings. Under no circumstances will a breeding stock long exceed the carrying capacity of a body of water. The practice of harvesting a crop of surplus fish for human use is biologically sound. The problem is to find out how large the surplus is and to make the water area produce a reasonable crop each year.

This booklet is intended to provide basic material for the study of some elementary principles in the conservation of fish. It is not a source of technical material.

The descriptions of many of the species of fish found in North Carolina streams have been omitted because this information was

published in 1947 under the title "Important Food and Game Fishes of North Carolina" and copies are available for distribution by the North Carolina Wildlife Resources Commission. Another bulletin giving more detail on the management of farm ponds, and which is distributed by the Commission, is "Management of Farm Fish Ponds", Bulletin No. 254, published by the Agriculture Experiment Station, Auburn, Alabama.

B. STREAM CONDITIONS

The first objective in the conservation and restoration of fish is the improvement of their surroundings. Like all other animals and plants, fish are limited in numbers by the carrying capacity of the environment in which they live. A body of water will support just so many pounds of fish, regardless of their size, and no amount of restocking can permanently increase the fish population beyond the capacity of the pond or stream to provide food, cover, reasonably clean and unpolluted water, and places for depositing, fertilizing, and hatching the eggs. If these favorable conditions and suitable temperatures prevail, if the water level is kept fairly constant throughout the year, and if the annual catch does not exceed the available surplus, the stream or pond will maintain a stable fish population.

1. Prevention of silting is a basic step in stream improvement.

a. Soil erosion is the most widespread source of damage to our streams. The silt which is carried into the streams by each rain keeps the water muddy, a condition unfavorable to most fish. Also it reduces the depth to which sunlight penetrates the water. Thus soil erosion limits plant growth and interferes with the regularity of stream flow.

b. The soil which finds its way into a stream comes either from the immediate vicinity or from cultivated land on the watershed some distance away. The latter causes the greater damage.

c. The control of erosion from the immediate watershed is largely a matter of establishing and maintaining a protective cover of grass and trees. If a new lake or pond is to be created by damming a stream, the vegetation on the watershed should be established before (or at least very soon after) the dam is built. If the watershed of a stream is to be used for pasture, the

number of livestock on the area should be restricted so that overgrazing will not increase erosion; all soil conservation practices on the land serve to protect the stream.

d. The control of erosion on cultivated areas located many miles from a stream is a more difficult problem that can be dealt with only through the cooperation of landowners, soil conservation agencies, and other conservationists.

e. A pond or lake can be partly protected against silting by means of a silt dam, desilting pond, stake checks, board checks, or wire checks at the point where the water is received from the source stream.

2. Maintenance of regular flow is a second major problem in stream management.

a. If a stream is to provide a suitable habitat for fish, it must have an adequate flow throughout the year. Some streams have dry beds in periods of low rainfall and many fish perish. Some shallow streams freeze dry in the winter, with consequent loss of fish.

b. Floods are destructive. Eggs and larvae of fish and other aquatic animals may be covered by silt or washed away. Adult fish may be carried outside the main channel and left to die when the water recedes. The accumulation of silt and undesirable debris may make stream conditions so unfavorable that the fish perish or leave. Stream conditions may be unfavorable to the growth of aquatic plants and animals used as food by the fish.

c. Regularity of stream flow depends upon a constant and reliable source of water. Spring-fed streams have the most nearly constant flow, but most streams in North Carolina are not fed by large springs. Streams flowing through well-established woodlands flow more evenly than streams with denuded watersheds. This fact indicates a definite relation between reforestation and stream improvement. In some streams flood-control dams make possible the storage of storm waters and their subsequent release during dry periods. It is important to understand, however, that dams built at certain points on a stream may be detrimental to other parts of the stream and may seriously interfere with the migration and spawning of fish. All streams should be managed on a multiple-use basis, and dams should be constructed only after careful study and investigation have shown that their construction is sound from the standpoint of the whole stream and

all the uses of the land drained by it. When dams are needed, adequate provision should be made at the time of planning and construction for fish and other resources of the stream.

3. The maintenance of plant life in streams is an important factor in stream improvement.

a. Plant growth is closely associated with regularity of stream flow. Plants must have time to become established in the water and along the shore, and this condition is impossible where the water level rises and falls frequently.

b. The encouragement of plant growth may require planting, transplanting, or other methods of introducing aquatic plants in and along streams, lakes, and ponds. Knowledge of the food habits of fish, insects, and other aquatic animals, as well as knowledge of the requirements of aquatic plants, is essential to stream improvement.

c. In lakes, green plants help to maintain favorable chemical conditions in the water. They take up some of the carbon dioxide given off by the animals and by decaying organic matter. In turn, they release oxygen which helps to maintain a chemical balance in the water, since it is used by the animals and fish.

4. A problem in maintaining a favorable balance between plants and animals is the provision of food, cover and water.

a. Food and cover are two of the most important factors in fish production.

b. The maintenance of food and cover is sometimes a difficult problem in large, newly-constructed lakes. This problem is especially evident in deep hydro-electric and flood-control reservoirs where there is wide fluctuation of the water level.

c. Plankton, composed of the tiny floating plants and animals, is the principal source of food for minnows and all young fish. Plankton also provides food for the smaller aquatic animals and forage fish which, in turn, are eaten by the larger fish.

d. In extreme cases, when the natural food supply is inadequate, supplementary food must be provided. Supplementary feeding is feasible, however, only in small areas and for short periods.

e. Protective cover is as necessary to fish as to land animals. In the water it takes the form of plants, rocks, submerged logs,

etc. Artificial shelters, such as brushpiles and logs, are sometimes needed in new lakes and ponds.

C. POLLUTION

Pollution is a major problem in the conservation of stream life in many North Carolina streams. It is not only a menace to public health; it also has other unwholesome effects. Three principal sources of pollution exist under North Carolina conditions:

1. Sewage is dumped into important streams or their tributaries by many cities and towns. Unfortunately, a great deal of sewage receives no chemical treatment before it is released into the streams. Whenever any kind of organic matter is broken down chemically by the bacteria in the water, the process uses up oxygen. In polluted waters or those choked with debris, fish are likely to die from lack of oxygen or be poisoned by the sewage itself.

2. Industrial and other chemical wastes exert greatest influence in the waters just below large cities. Even the small garage which dumps its waste oil into the local creek pollutes that stream and eventually the larger ones. Sawdust in the streams is chemically and mechanically injurious to fish.

3. Silt and debris carried into the streams by runoff water is the most serious general source of pollution everywhere in the state.

D. DRAINAGE

1. The digging of drainage ditches in agricultural lowlands has increased the volume and speed of the water which flows into the larger channels. As a result, some streams become too unstable to be satisfactory habitats.

2. Drainage of marshes, lakes, and ponds to reclaim land for agricultural use has destroyed nearly all of the aquatic life of some regions. This loss has been offset by the construction of new lakes, ponds, and reservoirs in recent years, but only to a small extent.

E. RESTOCKING

1. Improvement of habitat must precede, or at least accompany, restocking. The releasing of fish into water areas that do not meet these biological needs cannot permanently increase the annual catch unless this expensive practice is followed each year.

2. Restocking of some streams and the stocking of new ponds and lakes, however, is an important means of conservation. Local people are beginning to aid the state in this undertaking.

3. Many mountain streams are being stocked with rainbow, brook, and brown trout.

4. Under proper stream management, the increase of fish population should be expected to keep pace with the progress of stream improvement, even without annual restocking.

F. MANAGEMENT OF THE FISH CROP

1. As previously stated, the number of pounds of fish which can survive throughout the year in a given body of water is limited by natural conditions—food, cover, and the quantity and quality of water. This number represents the carrying capacity of the stream, lake, or pond.

2. The available crop of fish is the amount that can be taken without decreasing the brood stock.

3. If this crop is not taken and used by man, it will be destroyed by Nature because it cannot all survive. A reasonable amount of fishing, therefore, is a biologically sound practice in productive waters.

4. It is essential, however, that the combined kill by man and Nature shall not decimate the breeding stock. The code of fishing regulations enacted by the North Carolina Wildlife Resources Commission is intended to give adequate protection to the breeding reserve of each species.

G. THE VALUE OF FARM FISH PONDS

Each year, at least 1,000 new fish ponds are built in North Carolina. These ponds serve several important purposes. They provide the owners and their guests a place to fish, swim, and enjoy the numerous types of wildlife which frequent a pond. Fishing appeals to all persons, young and old alike, the wealthy and the poor.

To be successful, the pond should be properly constructed, with provision for drainage, have ample spillway for flood water, and a minimum of water under two feet in depth. Just enough water to keep the pond full is an ample water supply. Too much water

makes fertilization impractical, and a large watershed increases danger of flooding.

Warm-water fish ponds are stocked at the rate of 1,000 bluegill fingerlings and 100 largemouth bass fingerlings an acre. It is unwise to get a stock for a new pond from a stream or even another pond where a number of undesirable species may be taken along with the bass and bluegills desired. Fish may be obtained from the U. S. Fish and Wildlife Service or from the North Carolina Wildlife Resources Commission. A properly constructed, stocked, and managed pond may, under average conditions, be expected to produce one hundred fifty to three hundred pounds of fish an acre each year after the fish reach a size suitable for use.

The productivity of a pond can be increased by adding commercial fertilizer such as 6-8-6, at the rate of several hundred pounds an acre a year. The fertilizer stimulates the growth of micro-organisms which are fed upon by small fish, and these in turn are eaten by larger fish.

Frequently too many fish occur in a pond. Either the food supply must be increased to meet the needs of the fish present, or the numbers must be reduced. Fishing helps to keep a pond in balance, and should be started as soon as the fish stocked have spawned and are large enough to take.

XV. IMPORTANCE OF FRESH-WATER FISH RECREATIONAL VALUE

1. In North Carolina fresh-water fish are more important for recreation than for commercial use. Many more people fish than hunt. In 1948, North Carolina issued 146,938 fishing permits of all kinds and 53,904 combined hunting and fishing permits. The relative popularity of fishing as a sport is indicated by the fact that many more fishing permits than hunting permits were issued.

2. The recreational value of fishing cannot be accurately measured in terms of cash, though in some communities the recreation provided by the streams is a major source of income. Good fishing influences many occupations. The improvement of water areas for recreation is usually followed by the development of resorts, hotels, camps, restaurants, sportings goods stores, and filling stations. Thus many occupations—indeed, entire com-

munities in some places depend upon the maintenance of fishing.

3. The full development of the recreational facilities of North Carolina is an objective closely related to the problems of conserving fish, other wildlife, and water.

4. Virtually all of the rivers and lakes and streams in North Carolina have game fish, and these waters attract many thousands of people annually.

XVI. STRUCTURE AND ADAPTATIONS

A. EXTERNAL STRUCTURE

The following diagram shows the principal parts of a fish. It should be studied very carefully:

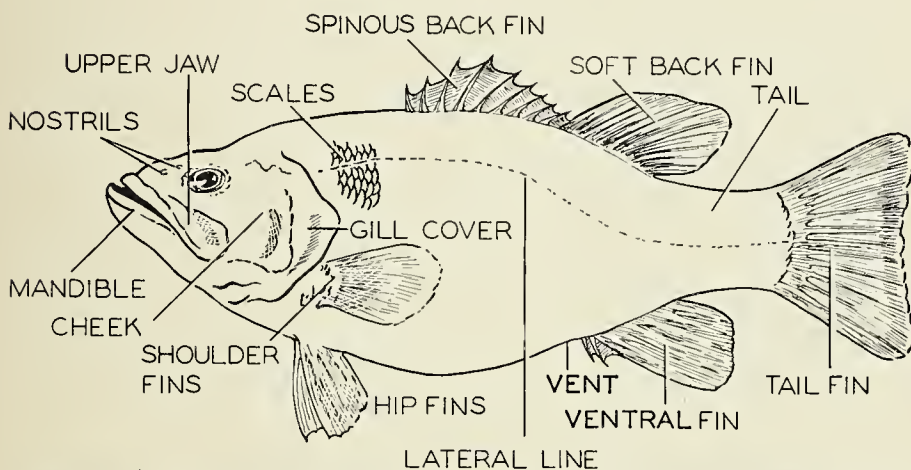


Diagram of a largemouth black bass showing the principal external areas and parts. The largemouth black bass is a widely distributed and popular North Carolina game fish.

1. The body of a fish has three divisions: head, trunk, and tail.
2. A fish is one of Nature's best examples of a streamlined structure.

a. The body gradually enlarges from head to trunk and tapers from trunk to tail.

- b. The shape of the fish enables it to move through the water with very little resistance.
3. Scales form the external covering of most fishes, though some species (catfishes, for example) have none.
- a. Scales overlap each other like shingles on a roof.
- b. A young fish may or may not have scales when it first hatches from the egg.
- c. Scales begin to appear, however, before the fish is very old. The striped bass develops scales when it is only about half an inch long. the salmons and trouts have scales after reaching a length of one or two inches.
- d. The number of scales on a fish remains practically constant throughout its life. As the body grows each scale is enlarged in proportion.
- e. The larger portion of a typical scale is embedded in the underskin or dermis; the smaller, flattened portion projects over the surface.
- f. The growth rings on a scale indicate the age of the fish, much as the annual rings indicate the age of a tree. A fish ordinarily grows most rapidly in summer, when the water is warm and food is abundant. During this period, therefore, the scales grow most rapidly to keep the body covered, and the rings on each scale are farther apart than in winter when growth is slower. Experienced workers can often calculate with some accuracy the former length of a fish at any given age, the age being indicated by the number of year marks on the scales. Alternating slow and rapid growth is characteristic of fish and other "cold-blooded" animals—i.e., those whose body temperature remains almost the same as that of their surroundings.
4. The skin of a fish is made up also of sensitive living tissue and bony scales.
- a. In a typical fish there is no outer layer of dead, dry tissue as there is in the human skin. Skin cells, like other living cells, must be kept moist. Since fishes live in the water, it is not necessary for the living part of the skin to be covered by dead and hardened material.
- b. The skin of a fish is covered by a laver of mucus or slime which is produced by the living cells. This slime serves as a lubricant, helping the fish to move through the water easily and permitting the scales to slide over one another. The slime also

protects the fish from the action of bacteria, fungi, and other skin parasites. Removal of the slime from large areas of the body may eventually kill the fish. For this reason, fish which are to be returned to the water should be handled gently with wet hands.

5. A typical fish has five kinds of fins.

a. The paired pectoral fins are usually located just behind the gills near the junction of the head and trunk. They correspond to the arms of the human body.

b. The paired pelvic fins are usually on the lower side of the body, often almost directly below the pectorals. They correspond to the legs of the human body.

c. The dorsal fin is situated along the middle of the back. Sometimes there are two or more in a row.

d. The ventral fin is on the lower side of the body behind the anus or vent. The ventral and pelvic fins often serve as brakes.

e. The caudal or tail fin is the one most used in swimming.

f. Fins also help the fish to maintain its balance in the water.

6. Gills enable a fish to breathe oxygen in the water. It does not use the oxygen which is part of the water itself (H_2O), but only that which is dissolved in the water. A fish would suffocate in boiled or distilled water.

a. The gills are made up of many fleshy rods containing tiny blood vessels arranged on bony arches. Most fishes have four pairs of these arches.

b. There are slits through which the water passes between the gill arches.

c. The blood vessels give the gills a red color and this may be taken as an indication of freshness.

d. As a fish swims, it gulps water into its mouth. The water is forced backward past the gills which absorb the oxygen and get rid of waste gas (carbon dioxide).

e. The gill rakers (projections on the arches) frequently form a network which collects insects, pieces of water plants, and other material that may clog the gills or that may be passed down the gullet as food.

f. The gills of every fresh-water fish are protected on the outside by a bony plate called the gill cover (operculum).

7. The eyes of the fish differ in structure from those of land animals.

a. A fish has no eyelids, though most land animals have lids which exclude dirt, and keep the eyeballs moist.

b. The iris (colored part) of the fish's eye is almost immovable and in the dim light under water does little to regulate the amount of light which enters the eye. In most other animals the regulating is done by changing the size of the opening (pupil), just as in a camera.

c. The lens of a fish's eye is spherical; the human eye has a more flattened lens.

d. Since a fish moves its eyes very little, and since they are located on the sides of the head, it has better lateral than forward vision. Its eyes look in almost opposite directions, while our eyes face in the same direction.

B. GENERAL ADAPTATIONS

1. The specific gravity of the fish's body is almost the same as that of water.

a. A 20-pound fish may need to use only enough energy to support about one pound of weight, the other 19 pounds being supported by the water.

b. Because a fish needs very little energy for support and is held back so little by friction, it can move swiftly and easily.

2. The bony framework of a fish is extremely light.

a. The principal group of muscles is a series of W-shaped segments fitted together along the entire length of the body on each side. It is this mass of flesh which is most commonly eaten.

b. Each muscle in contracting acts only on the region immediately surrounding it. Acting together, however, the muscles can change the shape or direction of the body.

c. A fish moves by alternately contracting and relaxing the muscles on the sides, thereby making the tail a propeller.

d. Each fin has its own set of muscles.

e. A fish has no muscles of the face except those which move the jaws.

f. A fish can move forward or backward, straight up or straight down, or it can remain stationary by using the fins to offset the effects of water currents and gravity.

g. Experiments have shown that a fish can swim without fins, but under these conditions its action is clumsy. The fins are needed to perform delicate, swift, or well-directed movements.

4. The maintenance of equilibrium (balance) depends upon structures in the head.

a. A fish has no outer ear or middle ear as man has.

b. In the inner ear sound waves set up are transformed into nerve impulses to the brain. Here also is the balancing machinery of the body, as in the human body.

c. Sounds under water can be heard by fish better than noises above the surface. Different species respond to different sounds, however. Trout may not react as quickly to the sound of a gun fired over the water as to the vibrations caused by foot-steps along the bank. Bass are said to notice the approach of a rowboat more readily than that of a motorboat. Experiments have shown that catfish can hear the sound of a whistle blown in the air.

d. The lateral line usually extends from the opening of the gills along the side to the tail. It contains sense organs by means of which a fish detects vibrations of very low frequency—as low as 6 vibrations a second sometimes. (To human ears such a sound would be only a dull rattle.) The lateral line is also believed to have an important use in adapting the fish to extreme changes of water temperature.

5. Color is an adaptation which has protective value under some conditions.

a. Experiments have shown that some fish placed on a dark background become dark; when the same fish are placed on a light background they become lighter in color.

b. The real importance of color change as a protective adaptation in most fishes is a disputed question. Different species differ widely in their ability to change color.

c. In general, fish are darker on the upper side and lighter on the under side. This color scheme tends to make the fish less easily visible from either above or below.

6. The teeth of most fishes are adapted for holding prey rather than for grinding.

a. Most fishes are mainly carnivorous (flesh eaters) and the teeth are sharply pointed.

b. Some plant-eating species have grinding teeth in the throat (pharynx); these are called pharyngeal teeth.

XVII. ACTIVITIES

1. *Shape of a fish.* Examine a living or preserved fish, to see how the body is streamlined. Note the gradual increase in size from head to trunk, the decrease in size from trunk to tail, whether the back is arched or flat, and whether the sides are rounded or flattened.

2. *Examination of scales.* Examine the scales of a fish and note how they overlap, the size and shape of the scales, and their texture or hardness. Compare the scales of a young fish with those of a mature fish of the same species, using a magnifying glass to see the growth rings.

3. *Examination of fins.* Identify the five kinds of fins. Examine the structure of fins and note their place of attachment to the body. Watch a fish swimming in a bowl and study the actions of the different fins.

4. *Structure of gills.* Examine the bony covering of the gills. (If a live fish is used, be careful not to injure it.) Lift the gill cover to see the arrangement of the gills. If a dead fish is used, put a thin section of a gill under a microscope to study the network of small blood vessels. Watch a living fish breathing in the water. Place a few drops of coloring matter in the water just in front of the mouth of a fish and watch the colored water as it comes out through the gills. Account for the common belief that a fish will drown if it cannot close its mouth. Is this fact true, and can a fish drown? Find the gill rakers; what is their use?

5. *Structure of skeleton.* Carefully remove the muscular covering of part of a fish and examine the bony framework. Examine the vertebrae to see how they are designed to permit the body to bend. Examine the skull. How does the thickness of the skull compare with that of the other bones?

6. *Arrangement of muscles.* Remove the skin from a part of the side of a fish. Separate the layers of muscles and find the W-shaped segments. How do these muscles operate?

7. *Mouth parts of a fish.* Open the jaws of a fish; which jaw is the longer? Notice the size of the mouth. Examine the teeth; notice their size, shape, and the way they are set in the jaws. Does the roof of the mouth contain a rough process adapted for crushing food?

8. *Inventory of local species.* Ask people who fish in your community what kinds are present and what are most abundant.

9. *Comparative study of local species.* Examine as many different kinds of fish as you can obtain. Compare them as to size, body shape, color, fins, and scales. If you cannot secure fish for this study, good pictures will be helpful.

10. *Habitat preference of local species.* Find out what species are found in the rivers, creeks, lakes, or ponds of your community. Does the presence of a species in a body of water necessarily indicate habitat preference?

11. *Observation of streams.* Look over some streams in your community. Do they flow regularly throughout the year? If not, why? Are their watersheds protected by grass and trees? Do the channels show evidence of silting?

12. *Prevention of silting.* Construct a barrier across the head of a pond to prevent silting. Drive one or several rows of stakes, and use boards or hog wire to catch debris and silt. Loose stone dams supported by stakes may also be used.

13. *Study of aquatic plants.* See how many kinds of water plants you can find in and along a stream. In what ways are plants helpful to fish and other water animals?

14. *A balanced aquarium.* Catch a few minnows and put them in a glass bowl or aquarium. Put some algae or other available water plants into the water. How do the plants and fish help each other? What is a balanced aquarium?

15. *Study of food and cover.* Visit a stream and look for the following kinds of cover: plants in and along the water; rocky ledges under the banks; sunken trees, brush, or logs. What water animals do you see? Are there minnows in the stream?

16. *Sewage.* Find out whether any of the streams in your community receive sewage from towns or cities. Inquire whether the sewage receives any chemical treatment before it is emptied into the stream. Has the fish population of the stream been affected by pollution?

17. *Industrial wastes.* If you live in or near a city situated on a stream, learn whether packing houses, garages, or other establishments discharge industrial waste into the water.

18. *Debris from farm land.* Look for trash, silt, or other debris which has washed into a stream from adjacent farm land. How could this be prevented?

19. *Drainage.* If there have been any drainage projects in your community, has the drainage affected fishing? How? Why?

20. *Inventory of new ponds and lakes.* Have new ponds or lakes been created in your community within the last five years? Have any of these been stocked with fish? What have been the results? Explain.

21. *Inquiry about depleted streams.* Inquire if fish were once present in streams which do not now contain fish. If so, why did the fish disappear?

22. *Visit to a hatchery.* Visit a fish hatchery and note: source of the water supply, methods of hatching and rearing the young, species of fish reared, and special equipment used. For what purpose are the fish being reared?

23. *Methods of harvesting the fish crop.* Secure as much information as possible concerning the methods used to catch fish in your community. Do any of the streams or lakes attract tourists and non-resident fishermen?

24. *North Carolina Fishing Regulations.* Secure a copy of the North Carolina fishing regulations from the North Carolina Wildlife Resources Commission and learn the legal dates for catching the game fish of the state. What other regulations govern the catching of the fish? What is the purpose of legal control of fishing?

Conservation Pledge

I GIVE MY
PLEDGE AS AN AMERICAN
TO SAVE AND FAITHFULLY
TO DEFEND FROM WASTE
THE NATURAL RESOURCES OF
MY COUNTRY — ITS SOIL AND
MINERALS, ITS FORESTS,
WATERS, AND
WILDLIFE.

PROTECT NORTH CAROLINA WILDLIFE

BY
PREVENTING FOREST FIRES
AND
REPORTING GAME LAW
VIOLATIONS